BANGALORE WATER SUPPLY AND SEWERAGE BOARD

CAUVERY BHAVAN, KEMPEGOWDA ROAD,
BANGALORE – 560 009

TENDER FOR THE WORK OF

The work of construction of Construction of 13.5 ML GLR at Kalkere with pumping station at Rammurthy Nagar.

Office of the Chief Engineer (Project)
BANGALORE WATER SUPPLY & SEWERAGE BOARD
3rd floor, Cauvery Bhavan,
K G road, Bangalore 560009.
Telephone – 080 22945108

e-mail – cep@bwssb.gov.in

TENDER REFERENCE :	:	BWSSB/CE(P)/ACE(Cst-DCW)/ / 2023-24 Dt: .2.2024
DATE OF PUBLICATION IN KPP-PORTAL	:	6.2.2024
LAST DATE FOR SUBMISSION OF TENDER IN E PORTAL	:	20.2.2024 up to 1400 hrs
TIME AND DATE OF OPENING OF TECHNICAL TENDER	:	21.2.2024 after 1600hrs.
PLACE OF OPENING OF TECHINCAL TENDER	:	Office of the Chief Engineer (Project), th 3rd floor, Cauvery Bhavan, K G road, Bangalore 560009.
TIME AND DATE OF OPENING OF PRICE TENDERS	:	Will be intimated to the Qualified Tenderers
PLACE OF OPENING OF PRICE TENDER	:	Will be intimated to the Qualified Tenderers
ADDRESS FOR COMMUNICATION	:	**Chief Engineer (Project)** 3rd floor, Cauvery Bhavan, K G road, Bangalore 560009. Telephone – 080 22945108 e-mail – cep@bwssb.gov.in

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SECTION 1:

BANGALORE WATER SUPPLY AND SEWERAGE BOARD
Office of the Chief Engineer (Project)
3rd Floor, Cauvery Bhavan, K.G. Road, Bangalore 560009
Website www.bwssb.org email cep@bwssb.gov.in
Telephone: +91-80- 22945108

INVITATION FOR SHORT TERM TENDER
(ONLY THROUGH KPP PORTAL)
(https.kppp.karnataka.gov.in)

IFT No.: BWSSB/CE(P)/ ACE(P)-2/ 1702 /2023-24 Dated: 05.02.2024

1. The **Office of the Chief Engineer (Project)** invites tender from eligible tenderers, for the construction of work detailed in the Table below through e-PROCUREMENT process with two stages tender procedure in line with the Rule 28 of the KTPP Act. The details regarding their qualification to take the tender (as detailed in ITT Clause 3) and the price tender shall be uploaded in the website of the e-procurement wizard. Technical details will be opened on the date and time mentioned in IFT clause 5 and evaluated. The price tender of the Tenderer, who is found to be qualified to execute the tendered works, will be opened on the date notified later. The Tenderers are advised to note the minimum qualification criteria specified in Section -2 Clause 3 of the Instructions to Tenderers (ITT) to qualify for award of the contract.

2. Tender documents may be downloaded through the KPPP wizard which will link to www.karnataka public procurement portal from 6.2.2024 **to 20.2.2024** on payment of fee indicated in the Table below, using online mod through KPP portal only**.** Interested tenderers may obtain further information at the Office of KPP portal. Tenderers will be issued a password and authorized for accessing the tender document in the website with URL: **www.karnataka public procurement portal**

3. The Bidders can download the e-tender document using their user ID –password, by accessing **www.karnataka public procurement portal** where electronic tender form is provided. Additional information related to e-tender process can be obtained through the above mentioned website. The electronic

tender will be operated as Two stage Tender system by opening the Technical details first and financial portion of the eligible tenderers later.

4. Tenders must furnish Earnest Money Deposit specified through KPPP only.

5. Contractors should have registration in KPWD of State Government organization, public sector under takings, other state Governments.

BANGALORE WATER SUPPLY AND SEWERAGE BOARD

Office of the Chief Engineer (Project)

3rd Floor, Cauvery Bhavan,
KG Road, BANGALORE 560 009

NO.BWSSB/CE(P)/ ACE (P)-2/ 1702 /2023-24 Date: 05.02.2024

INVITATION FOR SHORT TERM TENDER (IFT)
(Through e-Procurement Portal Only)

BWSSB, invites item rate e-Tenders in Two Stage Tender system from eligible contractors through e – Procurement Portal for the following work:

Sl. No	Name of Work	Cost of Tender Document including Taxes Rs.	Approx Amount put to Tender in crores Rs.	Bid Security in crores (Rs.)	Period of completion	Eligibility Criteria during last 5 years (2018-19, 2019-20, 2020-21, 2021-22, 2022-23)	
						Turnover (in all classes of Civil Engineering construction works) for any of the two years Rs. in crores	Performance & Work Qualification
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	The work of Construction of 13.5 ML GLR at Kalkere with pumping station at Rammurthy nagar.	To be specified by e-procurement cell.	10.47	0.104	18 months (Including monsoon period)	16.48	i.a)As prime contractor should have satisfactorily completed at least one similar work of construction of GLR with chlorination

							system, and allied works of value not less than Rs. 6.18 crores. b)The contractor should have constructed and commissioned 10 ML capacity RCC water retaining reservoir with RCC roof. c)Installation of pumps of minimum 3 Nos. with 70HP capacity under water supply scheme. ii. Executed in one year, the following minimum quantities a)RCC of M30 with shuttering : 1900 cum b) MS pipeline commissioned of 350mm dia & above: 150rmt

Note: : 1.The amount put to tender Rs. **10.47 crore** is excluding the GST.

2. The tenderer shall quote the rates excluding GST and the GST will be reimbursed as per actual.

3.The financial bid evaluation will be based on (1) of above note.

The tender documents can be downloaded through website www.karnataka

public procurement portal from: 6.2.2024 to 20.2.2024 The Last date for submission of completed tender documents through KPP portal is 20.2.2024 upto 1400 **hrs** and date of opening of tender on 21.2.2024 after 1600 hrs**.**

The details of work / eligibility of contractor etc can be had from website www.karnataka public procurement portal Further particulars may be obtained from the above office during office hours & also from website www.karnataka public procurement portal

Chief Engineer(Project)

BWSSB

"ADOPT RAIN WATER HARVESTING SYSTEM AND SAVE WATER"

I. Work Experience:

a. As prime contractor should have satisfactorily completed at least one similar work of construction of GLR with chlorination system, and allied works of value not less than Rs. 6.18 crores.

b. The contractor should have constructed and commissioned 10 ML capacity RCC water retaining reservoir with RCC roof.

c. Installation of pumps of minimum 3 Nos. with 70HP capacity under water supply scheme.

d. Executed in any one year, the following minimum quantities of work:

i. RCC of M 30 with shuttering : 1900 cum.

ii. MS pipeline commissioned of 350mm dia & above : 150 Rmt

II. Financial capabilities: -

1 **a.** To qualify for award of this contract, each Tenderer in its name should have achieved in at least two financial years a minimum financial turnover (in all classes of civil engineering construction works only) of **Rs. 16.48 crores**

b. Liquid assets and /or availability of credit facilities of no less than **Rs. 2.75 crores** (Credit lines/letter of credit/certificates from Nationalized/ Schedule banks in India for meeting the fund requirement etc.,

c. Assessed available tender capacity – (A x N x 1.5 - B)

Where A = Maximum value of civil engineering works executed in any one year during the last five years (updated to 2023-24 price level) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which tenders are invited.

B = Value, at 2023-24 price level, of existing commitments and on-going works to be completed during the next 6 month.

6. The last date for uploading of completed tender document is on 20.2.2024 upto **1400 hrs.**

7. Uploading signed copy of Form of Tender should be mandatory.

8. The bids will be opened at the office mentioned in para No.12 on 21.2.2021 **at 1600 hrs** in the presence of bidders or their authorized representatives. If the bid opening day remains as public holiday, Bids will be opened on the next working day at the original stipulated time.

9. Bidders can access tender documents from the website and upload the required details; those are mentioned in different sections in the bid document in to electronic tender box on the website. Scanned documents those are required to be furnished as per Section 2, 3 & 4 of the bid document shall be submitted through e-portal preferably in **PDF** format for clear vision.

10. The cost of the tender document once paid will not be refunded.

11. Applications / requisitions from joint venture Firms are not acceptable.

12. The cost of the tender document once paid will not be refunded.

13. The successful bidder would be required to give performance **bank guarantee of 5%** of the contract amount plus additional security for unbalanced bid amount from a Nationalized / Scheduled Indian Bank, with jurisdiction at Bangalore as specified in the clause no.29 of ITT, towards guarantee for completion of work within the stipulated period.

14. Bangalore Water Supply and Sewerage Board reserve the right to cancel or annul the entire or part of this process of invitation at any time without assigning any reason.

15. For any additional information regarding the above tender, the firms who are interested to quote, may contact office of the undersigned at the office address given below on all working days during office hours 1030hours to 1700 hours.

The Chief Engineer (Project),
Bangalore Water Supply and Sewerage Board
3rd Floor, Cauvery Bhavan D- Block,
Kempe Gowda Road, Bangalore - 560009
Karnataka, India.
Telephone: +91-80- 22945108

e-mail ID: cep@bwssb.gov.in
Or **visit Website** www.karnataka public procurement portal

16. List of documents to support qualification of bidder is to be uploaded to the e-Portal website www.karnataka public procurement portal

17. Bidders shall submit offers that comply with the requirements of the bid document, including the basic technical design as indicated in the drawing and specifications. Alternatives will not be considered. The attention of the bidders is drawn to clause 23 regarding the rejection of the bids, which are not substantially responsive to the requirement of the bid document.

18. Other details can be read from the tender documents.

19. Corrigendum/ Modification / Corrections, if any will be published in the website only.

-Sd/-
Chief Engineer (Project)
BWSSB.

SECTION 2:

INSTRUCTIONS TO TENDERERS (ITT)

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A. General

1. Scope of Tender

1.1 ***The Chief Engineer(Project), BWSSB,*** (Referred to as Employer in these documents) invites tenders following Two Cover e-procurement procedure, from eligible Tenderers, for the construction of work (as defined in these documents and referred to as "the work") detailed in the Table given in the Invitation for Tenders (IFT).

2. Eligible Tenderers

2.1 Tenderers shall not be under a declaration of ineligibility for corrupt and fraudulent practices issued by the Government of Karnataka

2.2 Tenders from Joint ventures are not acceptable.

3. Qualification of the Tenderer:

1 3.1 All Tenderers shall provide the requested information accurately and in sufficient detail in Section 3: Qualification information.

2 3.2 **To qualify for award of this contract, each Tenderer in its name should have in the last five years i.e. 2018-19 to 2022-23).**

3

(a) Achieved in at least two financial years a minimum financial turnover (in all classes of civil engineering construction works only) of Rs. **16.48 crores**.

(b) i. As prime contractor should have satisfactorily completed at least one similar work of construction of GLR with chlorination system, and allied works of value not less than Rs. 6.18 crores.

ii. The contractor should have constructed and commissioned 10 ML capacity RCC water retaining reservoir with RCC roof.

iii. Installation of pumps of minimum 3 Nos. with 70HP capacity under water supply scheme.

(c) Executed in any one year, the following minimum quantities of work:

a. RCC of M 30 with shuttering : 1900 cum.
b. MS pipeline commissioned of 350mm dia & above: 150 Rmt

(d) Deleted.

(e) Deleted.

3.3 **Each Tenderer should further demonstrate**:

0 Each Tenderer should further demonstrate:

a. Availability by owning 50% of the required / specified key & critical equipment for this work & remaining 50% can be deployed on lease / hire basis for all works provided, the relevant documents (commitment agreements etc.,) for availability for this work shall be furnished. Some of the equipments are as follows:

Sl No	**Details**	**Nos**
1	Batching plant of 30m3 / Hr capacity	1
2	Pin vibrators-60mm	10
3	Excavators (poclain)	4
4	Tractors	2
5	Dewater Pumps	4
6	Compressors	3
7	Pipe laying accessories like tripoid, chain, pully etc.,	2
8	Excavator, DG	2

[In case of hiring, agreement copy for such arrangement shall be furnished]

b. Liquid assets and /or availability of credit facilities of no less than **Rs. 2.75 crores** (Credit lines/letter of credit/certificates from Nationalized / Schedule banks in India for meeting the fund requirement etc.,

3.4 To qualify for a package of contracts made up of this and other contracts for which tenders are invited in this IFT, the Tenderer must demonstrate having experience and resources to meet the aggregate of the qualifying criteria for the individual contracts.

3.5 Sub-contractors' experience and resources shall not be taken into account in determining the Tenderer's compliance with the qualifying criteria except to the extent stated in 3.2 (d) and (e) above.

1 3.6 Tenderers who meet the above specified minimum qualifying criteria, will only be qualified, if their available tender capacity is more than the total tender value. The available tender capacity will be calculated as under:

Assessed available tender capacity = (A*N*1.5 - B)

where

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to **2021-22** price level) taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the works for which tenders are invited.

B = Value, at **2021-22** price level, of existing commitments and on-going works to be completed during the next **1** years (period of completion of the works for which Tenders are invited)*

Note: The statements showing the value of existing commitments and on-going works as well as the stipulated period of completion remaining for each of the works listed should be countersigned by the Employer in charge, not below the rank of an Executive Engineer or equivalent.

3.7 Even though the Tenderers meet the above criteria, they are subject to be disqualified if they have:

- made misleading or false representations in the forms, statements and attachments submitted in proof of the qualification requirements; and/or
- record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.; and/or
- participated in the previous Tender for the same work and had quoted unreasonably high tender prices and could not furnish rational justification.

4. One Tender per Tenderer:

4.1 Each tenderer shall submit only one tender for one package. A tenderer who submits or participates in more than one Tender (other than as a sub-contractor or in cases of alternatives that have been permitted or requested) will cause all the proposals with the Tenderer's participation to be disqualified.

5. Cost of Tendering:

5.1 The tenderer shall bear all costs associated with the preparation and submission of his tender, and the Employer will in no case be responsible and liable for those costs.

6. Site visit:

6.1 The Tenderer at his own responsibility and risk is encouraged to visit and examine the Site of Works and its surroundings and obtain all information that may be necessary for preparing the Tender and entering into a contract for construction of the Works. The cost of visiting the Site shall be at the Tenderer's own expense.

B. Tender documents

7. Content of Tender documents

7.1 The set of tender documents shall have all the Sections given in Page 2:

7.2 Both the sets should be completed and returned with the tender.

8. Clarification of Tender Documents

8.1 A prospective tenderer requiring any clarification of the tender documents may notify the Employer in writing or by cable (hereinafter "cable" includes telex, facsimile and e-mail) at the Employer's address indicated in the invitation to tender. The Employer will respond to any request for clarification which he receives earlier than 15 days prior to the deadline for submission of tenders. Copies of the Employer's response will be forwarded to all purchasers of the tender documents through e-mail, including a description of the enquiry but without identifying its source. Same will available in the website of e-procurement www.karnataka public procurement portal

8.2 Pre-tender meeting:

8.2.1 The tenderer or his authorized representative is invited to attend a pre-tender meeting which will take place at Office of the Chief Engineer (Project), Bangalore Water Supply & Sewerage Board, 3rd floor, Cauvery Bhavan, K.G.Road, Bangalore -560009 on **12.2.2024 at 3.00PM**

8.2.2 The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

8.2.3 The tenderer is requested to submit any questions in writing or by cable to reach the Employer not later than one week before the meeting.

8.2.4 Minutes of the meeting, including the text of the questions raised (without identifying the source of enquiry) and the responses given will be transmitted without delay to all purchasers of the tender documents. Any modification of the tender documents listed in Sub-Clause 7.1 which may become necessary as a result of the pre-tender meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 9 and not through the minutes of the pre-tender meeting.

8.2.5 Non-attendance at the pre-tender meeting will not be a cause for disqualification of a tenderer.

9. Amendment of Tender documents

9.1 Before the deadline for submission of tenders, the Employer may modify the tender documents by issuing addenda.

9.2 Any addendum thus issued shall be part of the tender documents and shall be communicated in writing or by cable to all the purchasers of the tender documents.

9.3 To give prospective Tenderers reasonable time in which to take an addendum into account in preparing their tenders, the Employer shall extend as necessary the deadline for submission of tenders, in accordance with Sub-Clause 16.2 below.

C. Preparation of Tenders

10. Documents comprising the Tender

10.1 The tender submitted in e-procurement portal by the Tenderer shall contain the documents as follows:

(a) Scanned copy of Earnest Money Deposit made ;

(b) Scanned copies of Qualification Information as per formats given in Section 3;

(c) The Tender (in the format indicated in Section 4)

(d) Priced Bill of Quantities (Section 9);

and any other materials required to be completed and submitted by Tenderers in accordance with these instructions. The documents listed under Sections 3, 4, 6 and 9 shall be filled in without exception. The Earnest Money Deposit shall be submitted to the Tender inviting authority on or before the time of submission mentioned in IFT. PHOTOCOPIES OF THE DOCUMENTS SHOULD BE NOTARISED.

(e) The Form of Tender (in the format indicated in Section 4) (Mandatory)

10.2 Deleted.

11. Tender prices

11.1 The contract shall be for the whole works as described in Sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Tenderer.

11.2 The bidder shall fill in the unit rates in figures for all items of the Works described in the Bill of Quantities. The system will automatically convert the unit rates mentioned in figures to words and also calculate the amount of that item as well as the total Bid value. *Items for which no rate is entered by the bidder will not be paid for by the Employer when executed and shall be deemed covered by the other rates in the Bill of Quantities*

11.3 All duties, taxes, and other levies payable by the contractor under the contract, or for any other cause, shall be included in the rates, prices and total Tender Price submitted by the Tenderer.

11.4 Deleted

12. Tender validity

12.1 Tenders shall remain valid for a period not less than **ninety days** after the deadline date for tender submission specified in Clause 16. A tender valid for a shorter period shall be rejected by the Employer as non-responsive.

12.2 In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the Tenderers may extend the period of validity for a specified additional period. The request and the Tenderers' responses shall be made in writing or

by e-mail. A Tenderer may refuse the request without forfeiting his earnest money deposit. A Tenderer agreeing to the request will not be required or permitted to modify his tender, but will be required to extend the validity of his earnest money deposit for a period of the extension, and in compliance with Clause 13 in all respects.

13. Earnest money deposit

13.1 The Tenderer shall furnish, as part of his tender, earnest money deposit in the amount as shown in column 2 of the Table of IFT for this particular work. This earnest money deposit shall be in favour of ***Chairman, BWSSB*** and may be in the form online mode through KPP portal only from any Nationalised / Scheduled Indian banks.

13.2 Instruments having fixed validity issued as earnest money deposit for the tender shall be valid for 45 days beyond the validity of the tender.

13.3 Any tender not accompanied by an acceptable earnest money deposit and not secured as indicated in Sub-Clauses 13.1 and 13.2 above shall be rejected by the Employer as non-responsive.

13.4 The earnest money deposit of unsuccessful Tenderers will be returned within 30 days of the end of the tender validity period specified in Sub-Clause 12.1.

13.5 The earnest money deposit of the successful Tenderer will be discharged when the Tenderer has signed the Agreement and furnished the required Performance Security.

13.6 The earnest money deposit may be forfeited:

(a) if the Tenderer withdraws the Tender after tender opening during the period of tender validity;
(b) if the Tenderer does not accept the correction of the Tender Price, pursuant to Clause 24; or
(c) in the case of a successful Tenderer, if the Tenderer fails within the specified time limit to
    (i) sign the Agreement; or
    (ii) furnish the required Security deposit

14. Format and signing of Tender

14.1 The completed bid comprising of documents indicated in ITB 10, should be uploaded in the **KPP portal only**through the website **www.eproc.karnataka.gov.in** along with scanned copies of requisite certificates those are mentioned in different sections in the bid document and scanned copy of Bid Security / EMD in case it is provided in the form of Banker's cheque/ Demand draft/Pay Order

14.2 All the documents should be uploaded to the **KPPP**. Tenderer should take a print out of the declaration letter provided in the website on company letter head and should sign, stamp and upload the same to the tender wizard of BWSSB.

14.3 Deleted

D. Submission of Tenders

15. Up-loading & submission of tenders

15.1 The tenders should be uploaded only through **e-procurement portal**. Tender should contain

A. Technical Tender consisting of following:

a. All the documents with required details in prescribed format; those are mentioned in different sections in the Tender. Form of Tender, Declaration statement regarding Customs/ Excise duty exemption for materials/ construction equipment brought to site as mentioned in Section 2, etc., shall be downloaded, filled with required details, signed, scanned & uploaded to the e-procurement portal website **www.kppp.karnataka.gov.in** on or before the time and date indicated in notification /Section I IFT.

b. **Tender security.** Tender security can be paid to through online (the details like reference number, date, name of the Bank and drawn in favour are to be registered on the tender wizard)

The above documents along with notarized copies of documentary evidences as indicated in Section—II ITT, Section-III Qualification information & Section IV Forms of Tender shall be scanned and uploaded to the website compulsorily, failing which tender will be rejected in view of incomplete bid document and

B. Financial Tender consisting of Bill of Quantities (file name: BOQ.xls). The tenderer shall down load the bill of quantities and key in the rates (in figures only) in the Bill of Quantities sheet and upload the same file on to the website on or before the time and date indicated in notification /Section I IFT.

Scanned copy of Bid security (as cited in IFT Para No.2) is to be uploaded to the KPP portal before **1400 hrs on, Dt : 2.2.2024.**

In case of failure of the tenderer to submit the same within stipulated time, their tender will be rejected.

NOTE:

1. URL of the Website for tender submission through e-procurement portal is as follows:

i www.karnataka public procurement portal**.**

ii **Chief Engineer (Project)**
Bangalore Water Supply and Sewerage Board,
3rd Floor, Cauvery Bavan,
K.G. Road, Bangalore560009
Karnataka, India.

Telephone: +91-80- 22945108

2. The details related to submission of tenders, downloading / uploading of documents or other details are available online in the help wizard, Vendor manual & FAQ of above website. The same is provided along with sample formats in Annexure-I of the Bid document for ready reference.

15.2 Deleted

15.3 Unique Identification Number will be automatically generated by the server with time - stamp and sent to the account of the bidder as an acknowledgement after bidder finally uploads the bids.

15.4 Deleted.

16. Deadline for submission of the Tenders

16.1 Tenders must upload all the tender documents in the KP-procurement portal not later than 20.2.2024 **Upto 1400 Hrs**. In the event of the specified date for the submission of tenders being changed / postponed by the Employer due to unforeseen circumstances, the corrigendum will be issued in the news paper & the deadline for submission of tenders will be intimated accordingly.

16.2 The Employer may extend the deadline for submission of tenders by issuing an amendment/corrigendum in accordance with Clause 9, in which case all rights and obligations of the Employer and the Tenderers previously subject to the original deadline will then be subject to the new deadline.

17. Late Tenders

17.1 The software of e-procurement system will not allow the Bidder to upload the documents after expiration of the stipulated date & time of Bid submission. The Bidder shall refer the server time, which will be displayed in the e-procurement portal of BWSSB. Employer will not be responsible for non-receipt of bids on the stipulated date & time prescribed in clause 16, due to Internet Problems, improper uploading or any other related problems. In case of connectivity problems, Tenderer may contact Helpdesk of the e-tender service provider and may also draw the attention of tender inviting authority.

18. Modification and Withdrawal of Tenders

18.1 Tenderers may “modify” and “withdraw” their tenders multiple numbers of times, until the deadline for submission of tenders by operating the relevant provision made in e-tendering. If the Tenderer withdraws the tender before the deadline for submission of tenders and later if he is interested to submit the tender once again, may do so within the stipulated date & time as mentioned in Clause 16. In this case within the stipulated date & time, the tenderer can once again submit the requisition to the officer inviting tenders for access to the withdrawn tender document for resubmission. For this tenderer need not make any additional

payment towards the cost of tender document. Communication of modification / withdrawal by other means will not be accepted.

18.2 Deleted.

18.3 No Tender may be modified after the deadline for submission of Tenders.

18.4 Withdrawal or modification of a Tender between the deadline for submission of Tenders and the expiration of the original period of Tender validity specified in Clause 12.1 above or as extended pursuant to Clause 12.2 may result in the forfeiture of the earnest money deposit pursuant to Clause 13.

18.5 Tenderers may offer discounts for individual items by simply modifying the quoted unit price in the Bill of Quantities. Also, Tenderer may enter their overall discount, at specified location in the Bill of Quantities only, by submitting tender modifications in accordance with this clause. Communication of discount by other means will not be accepted.

E. Tender opening and evaluation

19. Opening of Technical portion of Tenders and evaluation to determine qualified Tenderers:

19.1 The Employer will open the Technical details of all the Tenders received (except those withdrawn), including modifications made pursuant to Clause 18, in the presence of the Tenderers or their representatives on **21.2.2024 after 1600hrs .** In the event of the specified date of Tender opening being declared a holiday for the Employer, the Tenders will be opened at the appointed time and location on the next working day.

19.2 WITHDRAWAL proposal submitted pursuant to clause 18 shall be read out first and their bids shall not be opened.

19.3 The Tenderers names, the presence or absence of earnest money deposit (amount, format and validity), the submission of qualification information and such other information as the Employer may consider appropriate will be announced by the Employer at the opening.

19.4 The Employer shall prepare minutes of the Tender opening, including the information disclosed to those present in accordance with Sub-Clause 19.3.

19.5 The Price Tenders of all the Tenderers including modifications for Financial tenders can not be opened as this is programmed to open later after evaluation of the Technical details of the participating Tenderers.

19.6 The Employer will evaluate and determine whether each tender (a) meets the eligibility criteria defined in ITT Clause 2; (b) is accompanied by the required earnest money deposit as per stipulations in ITT Clause and (c) meets the minimum

qualification criteria stipulated in ITT Clause 3. The Employer will draw out a list of qualified Tenderers.

20. Opening of Price Tender of qualified Tenderers and evaluation:

20.1 The Employer will inform all the Qualified Tenderers the time, date and venue fixed for the opening of the price Tenders. The Employer will open the price tender of Qualified Tenderers at the appointed time and date in the presence of the Tenders or their representatives who choose to attend. In the event of the specified date of Price tender opening being declared a holiday for the Employer, the price tenders will be opened at the appointed time and location on the next working day.

20.2 Deleted.

20.3 The Tenderers' names, the Tender prices, the total amount of each Tender, any discounts, and withdrawals, and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening. No Tender shall be rejected at Tender opening.

20.4 The Employer shall prepare minutes of the Price Tender opening, including the information disclosed to those present in accordance with Sub-Clause 20.3.

21. Process to be confidential

21.1 Information relating to the examination, clarification, evaluation, and comparison of Tenders and recommendations for the award of a contract shall not be disclosed to Tenderers or any other persons not officially concerned with such process until the award to the successful Tenderer has been announced. Any effort by a Tenderer to influence the Employer's processing of Tenders or award decisions may result in the rejection of his Tender.

22 Clarifications of Tenders

22.1 To assist in the examination, evaluation, and comparison of Tenders, the Employer may, at his discretion, ask any Tenderer for clarification of his Tender, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by cable, but no change in the price or substance of the Tender shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Tenders in accordance with Clause 24.

22.2 Subject to sub-clause 22.1, no Tenderer shall contact the Employer on any matter relating to its Tender from the time of the Tender opening to the time the contract is awarded. If the Tenderer wishes to bring additional information to the notice of the Employer, it should do so in writing.

22.3 Any effort by the Tenderer to influence the Employer in the Employer's Tender evaluation, Tender comparison or contract award decisions may result in the rejection of the Tenderers' Tender.

23. Examination of Tenders and determination of responsiveness

23.1 Prior to the detailed evaluation of Tenders, the Employer will determine whether each Tender; (a) has been properly signed; and; (b) is substantially responsive to the requirements of the Tender documents like [(a)Form of Tender, (b)Declaration statement regarding Customs/ Excise duty exemption for materials/ construction equipment brought to site as mentioned in Section 2 etc.,] Scanned / uploaded [including documents those are required to be furnished as per Section 2, 3 & 4 of the tender,]; (c) is accompanied by the required securities and; (d) is substantially responsive to the requirements of the tendering documents.

23.2 A substantially responsive Tender is one which conforms to all the terms, conditions, and specifications of the Tender documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the Tender documents, the Employer's rights or the Tenderer's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Tenderers presenting substantially responsive Tenders.

23.3 If a Tender is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation.

24. Correction of errors

24.1 (a) Once the Tenderer key in the rates in figures, in the Bill of quantities provided, rate in words will be auto generated by the system.

(b) Once the Tenderer key in the rates in figures, in the Bill of quantities provided, the system will automatically calculate the amount of that item as well as the total Bid value.

24.2 Deleted

25. Evaluation and comparison of Tenders

25.1 The Employer will evaluate and compare only the Tenders determined to be substantially responsive in accordance with Clause 23.

25.2 Deleted.

25.3 The Employer reserves the right to accept or reject any variation, deviation, or alternative offer. Variations, deviations, and alternative offers and other factors which are in excess of

the requirements of the Tender documents or otherwise result in unsolicited benefits for the Employer shall not be taken into account in Tender evaluation.

25.4 The estimated effect of the price adjustment conditions under Clause 41 of the Conditions of Contract, during the implementation of the Contract, will not be taken into account in tender Evaluation

25.5 If the tender of the successful tenderer is seriously unbalanced in relation to the Employer's estimate of the cost of the work to be performed under the contract, the Employer may require the Tenderer to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 29 be increased at the expense of the successful Tenderer to a level sufficient to protect the Employer against financial loss in the event of default of the successful under the contract.

F. Award of Contract

26. Award criteria

26.1 Subject to Clause 27, the Employer will award the Contract to the Tenderer whose Tender has been determined to be substantially responsive to the Tender documents and who has offered the lowest evaluated Tender Price, provided that such Tenderer has been determined to be (a) eligible in accordance with the provisions of Clause 2, and (b) qualified in accordance with the provisions of Clause 3.

27. Employer's right to accept any Tender and to reject any or all Tenders

27.1 Notwithstanding Clause 26, the Employer reserves the right to accept or reject any Tender, and to cancel the Tender process and reject all Tenders, at any time prior to the award of Contract, without thereby incurring any liability to the affected Tenderer or Tenderers or any obligation to inform the affected Tenderer or Tenderers of the grounds for the Employer's action.

28. Notification of award and signing of Agreement

28.1 The Tenderer whose Tender has been accepted will be notified of the award by the Employer prior to expiration of the Tender validity period by cable, telex, e-mail or facsimile confirmed by registered letter. This letter (hereinafter and in the Conditions of Contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the

Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

28.2 The notification of award will constitute the formation of the Contract, subject only to the furnishing of Security deposit in accordance with the provisions of Clause 29.

28.3 The Agreement will incorporate all agreements between the Employer and the successful Tenderer. It will be kept ready for signature of the successful Tenderer in the office of Employer within 30 days following the notification of award along with the Letter of Acceptance. Within 20 days of receipt, the successful Tenderer will sign the Agreement and deliver it to the Employer.

28.4 Upon the furnishing by the successful Tenderer of the Performance Security, the Employer will promptly notify the other Tenderers that their Tenders have been unsuccessful.

29. Security deposit

29.1 Within 20 days of receipt of the Letter of Acceptance, the successful Tenderer shall deliver to the Employer a Security deposit in the form of Bank Guarantee for an amount equivalent to 5% of the Contract price plus additional security for unbalanced tenders in accordance with Clause 25.5 of ITT and Clause 44 of the Conditions of Contract. :

1 - Bank guarantee in favour of ***Chairman, BWSSB*** payable at ***Bangalore***

2 in the form given in Section 10;

29.2 If the security deposit is provided by the successful Tenderer in the form of a Bank Guarantee, it shall be issued either by a Nationalized/Scheduled bank.

29.3 The security deposit if furnished in cash or demand draft can, if requested, be converted to interest bearing securities at the cost of the contractor.

29.4 Failure of the successful Tenderer to comply with the requirements of Sub-Clause 29.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Earnest money deposit.

30 Advance Payment and Security:

30.1 The Employer will provide an advance payment on the contract price as stipulated in the Conditions of Contract, subject to the maximum amount as stated in the Contract Data.

31. Corrupt or Fraudulent practices

31.1 The GOK requires that the Tenderers/Suppliers/Contractors, observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, GOK :

(a) will reject a proposal for award if it determines that the Tenderer recommended for award has engaged in corrupt or fraudulent practices in competing for the contract in question;

(b) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a GOK contract if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing for, or in executing, a GOK contract.

31.2 Furthermore, Tenderers shall be aware of the provision stated in sub-clause 50.2 of the Conditions of Contract.

SECTION 3:

QUALIFICATION INFORMATION

The following form is to be downloaded, particulars are to be filled, scanned & uploaded by the Bidder, to the tender wizard of BWSSB **"**www.eproc.karnataka.gov.in**"** along with the Bid.

Note: The detailed procedure for downloading / uploading the documents will be available in Help wizard, Vendor manual & FAQ of the above mentioned Website.

The information to be filled in by the Tenderer hereunder will be used for purposes of computing Tender capacity as provided for in Clause 3 of the Instructions to Tenderers. This information will not be incorporated in the Contract.

1.1 Constitution or legal status of Tenderer [Attach copy]
Place of Registration _____
(Attach Copy)

Principal place of business: _____

1.2 Total value of civil engineering construction works executed and payments received in the last five years (in Rs. Lakhs)[1]
(Attach turnover certificate from Chartered Accounted along with balance sheets and P/L statement).
2018-19 _____
2019-20 _____
2020-21 _____
2021-22_____
2022-23_____

1.3 Work performed as Prime Contractor (in the same name) on works of similar nature over during the five years specified in 1.2 above.

Project Name	Name of Employer	Description of Work	Contract Number	Value of contract Rs. Lakhs	Date of issue of work order	Specified period of completion	Actual date of completion	Remarks explaining reasons for delay in completion of work
1	2	3	4	5	6	7	8	9

1.4 Quantities of work executed as prime contractor (in the same name) during the last five years specified in 1.2 above:

Year	Name of Work	Name of Employer	Quantity of work performed (cum)[2]			Remarks (Indicate contract reference)
			Cement Concrete	Masonry	Earthworks	
2018-19						
2019-20						

[1] Attach Certificate from Chartered Account by uploading the scanned copies

[2] Items of work for which data is requested should tally with that specified in ITT Clause 3

2020-21						
2021-22						
2022-23						

1.5 Information on works for which Tenders have been submitted and works which are yet to be completed as on the date of this Tender.

(A) Existing commitments and on-going works:

Description of Work	Place & State	Contract No. & Date	Name and Address of Employer	Value of Contract (Rs. lakhs)	Stipulated period of completion	Value of works[3] remaining to be completed (Rs. lakhs)	Anticipated date of completion
1	2	3	4	5	6	7	8

(B) Works for which Tenders already submitted:

Description of Work	Place & State	Name and Address of Employer	Estimated value of works (Rs. lakhs)	Stipulated Date period of completion	when decision is expected	Remarks if any
1	2	3	4	5	6	7

1.6. The following items of equipment are considered essential for successfully carrying out the works. The Tenderer should furnish all the information listed below.

Item of Equipment	Requirement[4]			Owned and available		Remarks
	No.	Capacity	Owned	Number/ Capacity	Age/ Condition	

1.7 Reports on the financial standing of the tenderer, such as profit and loss statements and auditor’s reports for the last five years;

1.8 Qualification and experience of the key technical and management personnel in permanent employment with the tenderer and those that are proposed to be deployed on this contract, if awarded.

1.9. Name, address, and telephone, telex, and fax numbers of the Tenderers' bankers who may provide references if contacted by the Employer.

[3] Contractor shall enclose / attach / up load all necessary certificates duly attested by the employer

[4] The Item of equipment, required number and capacity should match with those in ITT Clause 3.3(a) (Filled scanned & uploaded)

1.10 Evidence of access to financial resources to meet the qualification requirement specified in ITT Clause3.3 (b): Cash in hand, Letter of Credit etc. List them below and attach certificate from the Banker in the suggested format as under:

FORMAT OF BANKER'S CERTIFICATE /LINE OF CREDIT LETTER [TO BE ISSUED IN THE LETTER HEAD OF THE BANK BRANCH]

Reference Number (Sl No.) Place
Date
To
(Name & Address of the beneficiary)

This is to certify that Mr./ M/s. ..... [name of the customer] having is /their registered/administrative office at.....is a customer of our bank and are engaged in..... (nature of activity). If the .....customer is allotted/awarded with ..... (brief details of works], we may extend credit facilities upto Rs..... lakh, to meet his /their working capital requirement towards the execution of the said work order as per Loan policy of the Bank.

This credit is valid upto three months from the date of issue, that is upto dd/mm/yyyy.

Sd/-
Name of the Bank, Branch
Manger
Address:
.....

1.11 Proposals for subcontracting components of works amounting to more than 20% of the contract price .

Item of Work	Value of Sub-Contract	Identified Sub-Contractor (Name and address)	Experience of similar work [5]

1.12 Information on litigations in which the Tenderer is involved:

Other Party (ies)	Employer	Details of dispute	Amount involved	Remarks showing present status

1.13 The proposed methodology and program of construction, backed with equipment planning and deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as

[5] Attach Certificate from the respective Employers (scanned & Uploaded)

per technical specifications within the stipulated period of completion as per milestones.

SECTION 4:

FORM OF TENDER, LETTER OF ACEPTANCE, NOTICE TO PROCEED WITH THE WORK AND AGREEMENT FORM

Form of Tender

Description of the Works: The work construction of 13.5 ML GLR at Kalkere with pumping station at Rammurthy nagar.

Tender

To

Chief Engineer (Project)
Bangalore Water Supply and Sewerage Board,
3rd Floor, Cauvery Bhavan,
K.G. Road, Bangalore560009
Karnataka, India.

GENTLEMEN,

We offer to execute the Works described above in accordance with the Conditions of Contract accompanying this Tender.

This Tender and your written acceptance of it shall constitute a binding contract between us. We understand that you are not bound to accept the lowest or any Tender you receive.

The advance payment is required Rs……

We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We hereby confirm that this Tender complies with the Tender validity and Earnest money deposit required by the Tender documents.

We attach herewith our current income-tax clearance certificate.

Yours faithfully,

Authorized Signature:

Name & Title of Signatory:

_____

Name of Tenderer _____

Address: ----------

NOTE: This form shall be download, filled and printed on the Company letter head, Signed, Scanned and uploaded. Failure to furnish the signed copy will lead to Non-Responsive Tender. If the financial bid is disclosed in the technical bid, the tender will be technically non-responsive

Letter of Acceptance

(letterhead paper of the Employer)

_____[date]

To:

_____
[name and address of the Contractor]

Dear Sirs,

This is to notify you that your Tender dated _____ for execution of the _____ _____ [name of the contract and identification number, as given in the Instructions to Tenderers] for the Contract Price of Rupees —— _____ (_____) [amount in words and figures], as corrected and modified in accordance with the Instructions to Tenderers is hereby accepted by our Agency.

You are hereby requested to furnish Security deposit plus additional security for unbalanced tenders in terms of Clause 25.5 of ITT, in the form detailed in Clause 29.1 of ITT for an amount of Rs.———— within 20 days of the receipt of this letter of acceptance valid up to 30 days from the date of expiry of Defects Liability Period i.e. up to ..... and sign the contract, failing which action as stated in Para 29.4 of ITT will be taken.

Yours faithfully,

Authorized Signature
Name and Title of Signatory
Name of Agency

Issue of Notice to proceed with the work

(letterhead of the Employer)

———— (date)

To
———————————— (name and address of the Contractor)
————————————
————————————

Dear Sirs:

Pursuant to your furnishing the requisite security deposit as stipulated in ITT Clause 29.1 and signing of the contract agreement for the construction of ———————[name of the contract] a Tender Price of Rs.———————, you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully,

(Signature, name and title of signatory authorized to sign on behalf of Employer)

Agreement Form

Agreement

This agreement, made the _____day of _____20_____, between_____. _____[name and address of Employer] (hereinafter called "the Employer") of the one part and _____ _____ _____ _____ __ _____[name and address of contractor] (hereinafter called "the Contractor") of the other part.

Whereas the Employer is desirous that the Contractor execute _____ _____ _____ _____[name and identification number of Contract] (hereinafter called "the Works") and the Employer has accepted the Tender by the Contractor for the execution and completion of such Works and the remedying of any defects therein at a contract price of Rupees.....

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
   i) Letter of Acceptance;
   ii) Notice to proceed with the works;
   iii) Contractor's Tender;
   iv) Contract Data;
   v) Conditions of contract (including Special Conditions of Contract);
   vi) Specifications;
   vii) Drawings;
   viii) Bill of Quantities; and
   ix) Any other document listed in the Contract Data as forming part of the contract.
5. Jurisdiction of Courts/Arbitration: The sitting of arbitration shall be held at Bangalore only and nowhere else.

6. Dispute of any kind arising out of the contract shall be resolved within the jurisdiction of Bangalore City only and the parties agree and clearly understand that the courts/tribunals situated at Bangalore Metropolitan

City have exclusive jurisdiction for the redressal of the disputes arising out of the contract and at no other place.

7. The Parties further agree and understand that the place or places of issue of bank guarantee other than Bangalore will have no jurisdiction to resolve dispute of any kind relating to enforcement of the bank guarantees submitted by the contractor at Bangalore for the execution of the contract at Bangalore.

8. The contractor shall comply with all the legal requirements in the matter of employment of workmen and provide all safety gadgets to the workmen while working in the hazards place or conditions during the execution of the contract.

9. Contractor shall be fully responsible in the event of death of employee/workman during the execution of the work and liable to pay adequate compensation to the dependents of employee/workman as per law.

10. On his/their failure, if the Board is made to pay compensation the same shall be recovered by the Board from the contractor out of the amounts due to the contractor or by appropriate legal action.

11. If death of any employees occurs during execution of work due to negligence of contractor, the contract will be liable for termination.

12. In the event of such termination, the employer may consider blacklisting of firm after due notice.

13. In case of any death or accident the contract will be cancelled after following due process.

14. The Board will be entitled to claim exemplary damages from the contractor in case of death of any work man / employees of the contractor in any of the BWSSB works as it damages the reputation of the Board.

15. Road cutting machine should be used mandatorily while executing the work.

16. Any utilities encountered during execution if damaged by the contractor, the same need to be rectified immediately without any delay at his own cost with due approval from the concerned.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written.

The Common Seal of _____
was hereunto affixed in the presence of:
Signed, Sealed and Delivered by the said

_____

_____

in the presence of:
Binding Signature of Employer

_____

Binding Signature of Contractor _____

SECTION 5:

CONDITIONS OF CONTRACT

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Conditions of Contract

A. General

1. Definitions

1.1 Terms which are defined in the Contract Data are not also defined in the Conditions of Contract but keep their defined meanings. Bold letters are used to identify defined terms.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Tender.

Compensation events are those defined in Clause 38 hereunder.

The **Completion Date** is the date of completion of the Works as certified by the Employer in accordance with Sub Clause 46.1.

The **Contract** is the contract between the Employer and the Contractor to execute, complete and maintain the Works. It consists of the documents listed in Clause 2.2 below.

The **Contract Data** defines the documents and other information which comprise the Contract.

The **Contractor** is a person or corporate body whose Tender to carry out the Works has been accepted by the Employer.

The **Contractor's Tender** is the completed Tender document submitted by the Contractor to the Employer.

The **Contract price** is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; months are calendar months.

A **Defect** is any part of the Works not completed in accordance with the Contract.

The **Defects liability period** is the period named in the Contract Data and calculated from the Completion Date.

The **Employer** is the party who will employ the Contractor to carry out the Works.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The **Initial Contract price** is the Contract Price listed in the Employer's Letter of Acceptance.

The **Intended Completion Date** is the date on which it is intended that the Contractor shall complete the Works. The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Employer by issuing an extension of time.

Materials are all supplies, including consumables, used by the contractor for incorporation in the Works.

Plant is any integral part of the Works which is to have a mechanical, electrical, electronic or chemical or biological function.

The **Site** is the area defined as such in the Contract Data.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Employer.

The **Start Date** is given in the Contract Data. It is the date when the Contractor shall commence execution of the works. It does not necessarily coincide with any of the Site Possession Dates.

A **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.

A **Variation** is an instruction given by the Employer which varies the Works.

The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

2. Interpretation

2.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Employer will provide instructions clarifying queries about the Conditions of Contract.

2.2 The documents forming the Contract shall be interpreted in the following order of priority:

(1) Agreement
(2) Letter of Acceptance, notice to proceed with the works
(3) Contractor’s Tender
(4) Contract Data
(5) Conditions of Contract
(6) Specifications
(7) Drawings
(8) Bill of quantities and
(9) any other document listed in the Contract Data as forming part of the Contract.

3. Law governing contract

3.1 The law governing the Contract is the Laws of India supplanted by the Karnataka Local Acts.

4. Employer's decisions

4.1 Except where otherwise specifically stated, the Employer will decide contractual matters between the Employer and the Contractor.

5. Delegation

5.1 The Employer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

6. Communications

6.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

7. Subcontracting

7.1 Deleted

8. Other Contractors

8.1 The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Employer.

9. Personnel

9.1 The Contractor shall employ the technical personnel (of number and qualifications) as may be stipulated by GOK from time to time during the execution of the work. The technical staff so employed shall be available at site as may be stipulated by the Employer.

9.2 If the Employer asks the Contractor to remove a person who is a member of the Contractor's staff or his work force stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the work in the Contract.

10. Employer's and Contractor's risks

10.1 The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks which this Contract states are Contractor's risks.

11. Employer's risks

11.1 The Employer is responsible for the excepted risks which are:

(a) rebellion, riot commotion or disorder unless solely restricted to employees of the Contractor or his Sub-Contractors arising from the conduct of the Works; or

(b) a cause due solely to the design of the Works, other than the Contractor's design; or

(c) any operation of the forces of nature (in so far as it occurs on the Site) which an experienced contractor:

(i) could not have reasonably foreseen; or

(ii) could reasonably have foreseen, but against which he could not reasonably have taken at least one of the following measures;

(A) prevent loss or damage to physical property from occurring by taking appropriate measures or
(B) insure against such loss or damage

12. Contractor's risks

12.1 All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks are the responsibility of the Contractor.

13. Insurance:

13.1 The Contractor shall prior to commencing the works, effect and thereafter maintain insurances , in the joint names of the Employer and the Contractor, (cover from the first working day after the Start Date to the end of Defects Liability Period), in the amounts stated in the Contract Data :

(a) for loss of or damage to the Works, Plants and Materials and the Contractor's equipment;
(b) for liability of both Parties for loss, damage, death and injury to third parties or their property arising out of the Contractor's performance of the Contract including the Contractor's liability for damage to the Employer's property other than the Works and
(c) for liability of both Parties and of any Employer's representative for death and injury to the Contractor's personnel except to the extent that liability arises from the negligence of the Employer, any Employer's representative or their Employees.

13.2 Policies and certificates for insurance shall be delivered by the Contractor to the Employer for his approval before the Start Date. All such insurance shall provide for compensation to be payable to rectify the loss or damage incurred. All payments received from insurers relating to loss or damage shall be held jointly by the Parties and used for the repair of the loss or damage or as compensation for loss or damage that is not to be repaired.

13.3 If the Contractor fails to effect or keep in force any of the insurances referred to in the previous sub-clauses or fails to provide satisfactory evidence, policies or receipts, the Employer may without prejudice to any other right or remedy, effect insurance for the cover relevant to such default and pay the premiums due and recover the same as a deduction from any other monies due to the Contractor. If no payment is due, the payment of the premiums shall be a debt due.

13.4 Alterations to the terms of insurance shall not be made without the approval of the Employer.

13.5 Both Parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports:

14.1 The Contractor, in preparing the tender, shall rely on any site investigation reports referred to in the Contract data, supplemented by any information available to the Tenderer.

15. Queries about the Contract Data

15.1 The Employer will clarify queries on the Contract Data.

16. Contractor to construct the Works

16.1 The Contractor shall construct the Works in accordance with the Specification and Drawings.

17. The Works to be completed by the Intended Completion Date

17.1 The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the program submitted by the Contractor, as updated with the approval of the Employer, and complete them by the Intended Completion Date.

18. Approval by the Employer:

18.1 The Contractor shall submit Specification and drawings showing the proposed Temporary Works to the Employer, who is to approve them if they comply with the Specifications and Drawings.

18.2 The Contractor shall be responsible for the design of Temporary Works

18.3 The Employer’s approval shall not alter the Contractor’s responsibility for design of the Temporary Works.

18.4 The Contractor shall obtain approval of third parties to the design of third parties to the design of the temporary Works where required.

18.5 All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Employer before their use.

19. Safety

19.1 The Contractor shall be responsible for the safety of all activities on the Site.

20. Discoveries

20.1 Anything of historical or other interest or of significant value unexpectedly discovered on the Site is the property of the Employer. The Contractor is to notify the Employer of such discoveries and carry out the Employer's instructions for dealing with them.

21. Possession of the Site

21.1 The Employer shall give possession of all parts of the Site to the Contractor. If possession of a part is not given by the date stated in the Contract Data the Employer is deemed to have delayed the start of the relevant activities and this will be Compensation Event.

22. Access to the Site

22.1 The Contractor shall allow the Employer and any person authorized by the Employer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plant are being manufactured / fabricated / assembled for the works.

23. Instructions

23.1 The Contractor shall carry out all instructions of the Employer which comply with the applicable laws where the Site is located.

24. Procedure for resolution of Disputes:

24.1 If the Contractor is not satisfied with the decision taken by the Employer, the dispute shall be referred by either party to Arbitration within 30 days of the notification of the Employer’s decision.

24.2 If neither party refers the dispute to Arbitration within the above 30 days, the Employer’s decision will be final and binding.

24.3 The Arbitration shall be conducted in accordance with the arbitration procedure stated in the Special Conditions of Contract.

B. Time Control

25. Program

25.1 Within the time stated in the Contract Data the Contractor shall submit to the Employer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works.

25.2 The Employer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Employer again at any time. A revised Program is to show the effect of Variations and Compensation Events.

26. Extension of the Intended Completion Date

26.1 The Employer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date.

26.2 The Employer shall decide whether and by how much to extend the Intended Completion Date within 21 days of the Contractor asking the Employer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information.

27. Delays ordered by the Employer

27.1 The Employer may instruct the Contractor to delay the start or progress of any activity within the Works.

28. Management meetings

28.1 The Employer may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the progress achieved and the plans for remaining work.

28.2 The responsibility of the parties for actions to be taken is to be decided by the Employer either at the management meeting or after the management meeting and stated in writing to be distributed to all who attended the meeting.

C. Quality Control

29. Identifying defects

29.1 The Employer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Employer may instruct the Contractor to search for a Defect and to uncover and test any work that the Employer considers may have a Defect

30. Tests

30.1 If the Employer instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no Defect the test shall be a Compensation Event.

31. Correction of defects

31.1 The Employer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion and is defined in the Contract Data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

31.2 Every time notice of a Defect is given, the Contractor shall correct the notified Defect within the length of time specified by the Employer’s notice.

32. Uncorrected defects

32.1 If the Contractor has not corrected a Defect within the time specified in the Employer’s notice, the Employer will assess the cost of having the Defect corrected, and the Contractor will pay this amount.

D. Cost Control

33. Bill of Quantities (BOQ)

33.1 The BOQ shall contain items for the construction, installation, testing, and commissioning work to be done by the Contractor.

33.2 The BOQ is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the BOQ for each item

34. Variations

34.1 The Employer shall have power to order the Contractor to do any or all of the following as considered necessary or advisable during the progress of the work by him

(a) Increase or decrease of any item of work included in the Bill of Quantities (BOQ);
(b) Omit any item of work;
(c) Change the character or quality or kind of any item of work;
(d) Change the levels, lines, positions and dimensions of any part of the work;
(e) Execute additional items of work of any kind necessary for the completion of the works; and
(f) Change in any specified sequence, methods or timing of construction of any part of the work.

34.2 The Contractor shall be bound to carry out the work in accordance with any instructions in this connection, which may be given to him in writing by the Employer and such alteration shall not vitiate or invalidate the contract.

34.3 Variations shall not be made by the Contractor without an order in writing by the Employer, provided that no order in writing shall be required for increase or decrease in the quantity of an item appearing in the BOQ so long as the work executed conforms to the approved drawings.

34.4 The Contractor shall promptly request in writing the Employer to confirm verbal orders and the officer issuing oral instructions shall confirm it in writing with in 30days, failing which the work shall be carried out as though there is no variation. In case variation is approved, it shall be accompanied by BOQ, failing which the contractor shall be responsible for deviation, if any.

35. Payments for Variations

35.1 Payment for increase in the quantities of an item in the BOQ up to 25% of that provided in the Bill of Quantities shall be made at the rates quoted by the Contractor.

35.2 For quantities in excess of 125% of the tendered quantity of an item as given in the BOQ, the Contractor shall be paid at the rate entered in or derived from in the Schedule of Rates (applicable for the area of the work and current at the time of award of contract) plus or minus the

overall percentage of the original tendered rates over the current Schedule of Rates prevalent at the time of award of contract.

35.3 If there is no rate for the additional, substituted or altered item of the work in the BOQ, efforts would be made to derive the rates from those given in the BOQ or the Schedule of Rates (applicable for the area of the work and current at the time of award of contract) and if found feasible the payment would be made at the derived rate for the item plus or minus the overall percentage of the original tendered rates over the current Schedule of Rates prevalent at the time of award of contract

35.4 If the rates for additional, substituted or altered item of work cannot be determined either as at 35.1 or 35.2 or 35.3 above, the Contractor shall be requested to submit his quotation for the items supported by analysis of the rate or rates claimed, within 7 days.

1 35.5 If the Contractor's quotation is determined unreasonable, the Employer may order the Variation and make a change to the Contract Price which shall be based on Employer’s own forecast of the effects of the Variation on the Contractor's costs.

35.6 If the Employer decides that the urgency of varying the work would prevent a quotation being given and considered without delaying the work, no quotation shall be given and the Variation shall be treated as a Compensation Event.

35.7 Under no circumstances the Contractor shall suspend the work on the plea of non-settlement of rates for items falling under this Clause.

36. Submission of bills for payment

36.1 The Contractor shall submit to the Employer monthly bills of the value of the work completed less the cumulative amount paid previously.

36.2 The Employer shall check the Contractor's bill and determine the value of the work executed which shall comprise of (i) value of the quantities of the items in the BOQ completed and (ii) valuation of Variations and Compensation Events.

36.3 The Employer may exclude any item paid in a previous bill or reduce the proportion of any item previously paid in the light of later information.

37. Payments

37.1 Payments shall be adjusted for deductions for advance payments, other recoveries in terms of the contract and taxes, at source, as applicable under the law. The Employer shall pay the Contractor the within 60 days of submission of bill. The Contractor shall be liable to pay liquidated damages for shortfall in progress. For Progress beyond the agreed program, payment is subject to availability of the grants.

37.2 Items of the Works for which no rate or price has been entered in will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

38. Compensation events

38.1 The following are Compensation events unless they are caused by the Contractor:

(a) The Employer does not give access to a part of the Site by the Site Possession Date stated in the Contract Data.
(b) The Employer orders a delay or does not issue drawings, specifications or instructions required for execution of works on time.
(c) The Employer instructs the Contractor to uncover or to carry out additional tests upon work which is then found to have no Defects.
(d) The Employer gives an instruction for dealing with an unforeseen condition, caused by the Employer, or additional work required for safety or other reasons.
(e) The effect on the Contractor of any of the Employer's Risks.
(f) The Employer unreasonably delays issuing a Certificate of Completion.
(g) Other Compensation Events listed in the Contract Data or mentioned in the Contract.

38.2 If a Compensation Event would cause additional cost or would prevent the work being completed before the Intended Completion Date, the Contract Price shall be increased and/or the Intended Completion Date is extended. The Employer shall decide whether and by how much the Contract Price shall be increased and whether and by how much the Intended Completion Date shall be extended.

38.3 As soon as information demonstrating the effect of each Compensation event upon the Contractor's forecast cost has been provided by the Contractor, it is to be assessed by the Employer and the Contract Price shall be adjusted accordingly. If the Contractor's forecast is deemed unreasonable, the Employer shall adjust the Contract Price based on Employer's own forecast. The Employer will assume that the Contractor will react competently and promptly to the event.

38.4 The Contractor shall not be entitled to compensation to the extent that the Employer's interests are adversely affected by the Contractor not having given early warning or not having cooperated with the Employer.

39. Tax

39.1 The rates quoted by the Contractor shall be deemed to be inclusive of the sales and other taxes that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

40. Price Adjustment:

40.1 Contract price shall be adjusted for increase or decrease in rates and prices of materials, fuels and lubricants in accordance with the following principles and procedures and as per formulae given in the Contract Data.

1 (a) The price Adjustment shall apply for the work done from the date of commencement up to the end of original period of completion or extensions granted by the Employer and shall not apply to work carried out beyond the stipulated period of completion for reasons attributable to the Contractor;

2

3 (b) Price Adjustment shall be admissible from the date of opening of tenders (original or extended)

4 (c) The price adjustment shall be determined during each quarter from the formulae given in Contract Data.

5 (d) Following expressions and meanings are assigned to the work done during the quarter:

R = Total value of work done during the quarter. It will exclude value for works executed under variations for which price adjustment (if any) will be worked out separately based on the terms mutually agreed.

40.2 To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other Clauses in the Contract, the unit rates included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.

41. Liquidated damages

41.1 The Contractor shall pay liquidated damages to the Employer at the rate per day stated in the Contract Data for each day that the Completion Date is later than the Intended Completion Date (for the whole of the works or the milestone as stated in the Contract Data). The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.

41.2 If the Intended Completion Date is extended after liquidated damages have been paid, the Employer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment of bill.

42. Advance Payments:

42.1 The Employer shall make payment to the Contractor of the amounts stated in the Contract Data by the date stated in the Contract Data, against provision by the Contractor of an unconditional bank guarantee in a form acceptable to the Employer issued by a Nationalized/Scheduled Bank in amounts equal to the advance payment. The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on the advance payment.

42.2 The Contractor is to use the advance payment only to pay for Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been

used in this way by supplying copies of invoices or other documents to the Employer.

42.3 The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuation of the work done, variations, price adjustments, compensation events or liquidated damages.

43. Securities:

43.1 The Security deposit (including additional security for unbalanced tenders) shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in an amount and form and type of instrument acceptable to the Employer. The Security deposit shall be valid until a date 30 days from the date of expiry of Defects Liability Period and the additional security for unbalanced tenders shall be valid until a date 30 days from the date of issue of the certificate of completion.

44. Cost of Repairs:

44.1 Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

E. Finishing the Contract

45. Completion

45.1 The Contractor shall request the Employer to issue a Certificate of Completion of the Works and the Employer will do so upon deciding that the Work is completed.

46. Taking over

46.1 The Employer shall take over the Site and the Works within seven days of issuing a certificate of Completion.

47. Final account

47.1 The Contractor shall supply to the Employer a detailed account of the total amount that the Contractor considers payable under the Contract before the end of the Defects Liability Period. The Employer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 90 days of receiving the Contractor's account if it is correct and complete. If it is not, the Employer shall issue within 90 days a schedule that states the scope of the corrections or additions that are necessary. If the Final Account is still unsatisfactory after it has been resubmitted, the Employer shall decide on the

amount payable to the Contractor and make payment within 60 days of receiving the Contractor's revised account.

48. As built drawings and /or Operating and Maintenance Manuals

48.1 If "as built"[6] Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

48.2 If the Contractor does not supply the Drawings by the dates stated in the Contract Data, or they do not receive the Employer's approval, the Employer shall withhold the amount stated in the Contract Data from payments due to the Contractor.

49. Termination

49.1 The Employer may terminate the Contract if the other party causes a fundamental breach of the Contract.

49.2 Fundamental breaches of Contract include, but shall not be limited to the following:

(a) the Contractor stops work for 45 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Employer;

(b) The Contractor becomes bankrupt or goes into liquidation other than for a reconstruction or amalgamation;

(c) the Employer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Employer;

(d) the Contractor does not maintain a security which is required;

(e) the Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and

(f) if the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in the executing the Contract.

For the purpose of this paragraph : "corrupt practice" means the offering, giving, receiving or soliciting of any thing of value to influence the action of a public official in the procurement process or in contract execution. "Fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Borrower, and includes collusive practice among Tenderers (prior to or after Tender submission) designed to establish Tender prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition."

49.3 When either party to the Contract gives notice of a breach of contract to the Employer for a cause other than those listed under Sub Clause

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[6] Completion Drawings

49.2 above, the Employer shall decide whether the breach is fundamental or not.

49.4 Notwithstanding the above, the Employer may terminate the Contract for convenience.

49.5 If the Contract is terminated the Contractor shall stop work immediately, make the Site safe and secure and leave the Site as soon as reasonably possible.

50. Payment upon Termination

50.1 If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Employer shall prepare bill for the value of the work done less advance payments received up to the date of the bill, less other recoveries due in terms of the contract, less taxes due to be deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract Data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

50.2 If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Employer shall prepare bill for the value of the work done, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the contract, and less taxes due to be deducted at source as per applicable law and make payment accordingly.

51. Property

51.1 All materials on the Site, Plant, Equipment, Temporary Works and Works are deemed to be the property of the Employer, if the Contract is terminated because of a Contractor’s default.

52. Release from performance

52.1 If the Contract is frustrated by any event entirely outside the control of either the Employer or the Contractor the Employer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which commitment was made

F. Special Conditions of Contract

1. Labour :

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Employer, deliver to the Employer a return in detail, in such form and at such intervals as the Employer may prescribe, showing the staff and the numbers of the several classes of labour from time to time employed by the Contractor on the Site and such other information as the Employer may require.

2. Compliance with labour regulations :

During continuance of the contract, the Contractor and his sub contractors shall abide at all times by all existing labour enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labour law in future either by the State or the Central Government or the local authority. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, Employer shall have the right to deduct any money due to the Contractor including his amount of security deposit. The Employer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

3. Protection of Environment:

The contractor shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or others resulting from pollution, noise or other causes arising as a consequence of his methods of operation. During continuance of the contract, the contractor and his sub-contractors shall abide at all times by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, bye-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority.

4. Arbitration (Clause 24)

4.1 General Conditions of Dispute Adjudication Board Agreement.

If any dispute arises between the parties in connection with, or arising out of , the Contract or the execution of the works shall be adjudicated by the DBA comprising of 3 members constitute by:

a. Additional Chief Engineer, BWSSB as Employer representative,
b. The " Contractor", and
c. The "Member" third party who is being identified/nominated jointly by both Employer and Contractor.

If either party is dissatisfied with the DAB's decision, then either Party may, within 28days after receiving the decision, give Notice to the other party of its dissatisfaction. If the DAB fails to give its decision within period prescribed, then either party may, within 28 days after this period has expired, give Notice to the other Party of its dissatisfaction. Then only the procedure of 4.2 shall be initiated.

4.2 The procedure for arbitration shall be as follows:

(a) In case of dispute or difference arising between the Employer and the Contractor relating to any matter arising out of or connected with this agreement it shall be settled in accordance with the Arbitration and Conciliation Act 1996. The disputes or differences shall be referred to a Sole Arbitrator. The Sole Arbitrator shall be appointed by agreement between the parties; failing such agreement, by the Appointing Authority (any one of the Organizations as per list enclosed in Annexure)

(b) Arbitration proceedings shall be held at ***Bangalore***, Karnataka, India

(c) The cost and expenses of arbitration proceedings will be paid as determined by the Arbitrator. However the expenses incurred by each party in connection with the preparation, presentation, etc., shall be borne by each party itself.

(d) Performance under the contract shall continue during the arbitration proceedings and payments due the Contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceedings.

Annexure:

LIST OF ORGANIZATIONS WHO ARE CONSIDERED AS APPOINTING AUTHORITY FOR APPOINTMENT OF ARBITRATORS

1 1. Indian Council of Arbitration, India;
2 2. International Centre for Alternative Disputes Resolution (India);
3 3. Indian Roads Congress;
4 4. Indian Building Congress;
5 5. Indian Institute of Bridge Engineers;
6 6. Indian Institute of Public Health Engineers;
7 7. Institute of Water Works

[32] Add any other Organization considered suitable.

5 Contractor to Co-ordinate his Work with Other Contractors

5.1 The Contractor has to co-ordinate with the other concerned Contractors as already specified in Conditions of Contract for all such works as per the directions of Engineer in charge at no extra cost.

6 **Continuation of Work:**

6.1 In case of the death of a contractor after executing the agreement / commencement of the work, his legal heir, if any eligible registered contractor and willing, can execute and complete the work at the accepted tender rates irrespective of the cost of the work.

7. **Project Monitoring Consultant:**

This project will be executed under the super vision of Project Monitoring Consultant appointed by the Board for checking the measurements, quality assurance, quantity verification, documentation and reporting of the work status. The fee for the third-party inspection shall be paid by the Employer.

All the equipment materials which are to be tested at factory based on QAP approved by the Board, the cost of inspection need to be borne by the Contractor which includes accommodation/ TA/DA/food etc.

8. The contractor shall ensure the ESI and Provident Fund registration of the workers/labourers engaged in the work as per the Labour laws.

9. **Jurisdiction of Courts /Arbitration**: The sitting of Arbitration shall be held at Bangalore only and nowhere else.

10. Dispute of any kind arising out of the contract shall be resolved within the jurisdiction of Bangalore City only and the parties agree and clearly understand that the courts / tribunals situated at Bangalore Metropolitan City have exclusive jurisdiction for the redressal of the disputes arising out of the contract and at no other place.

11. The parties further agree and understand that the place or places of issue of Bank Guarantee other than Bangalore will have no jurisdiction to resolve dispute of any kind relating to enforcement of the bank guarantees submitted by the contractor at Bangalore for the execution of the Contract at Bangalore.

12. The contractor shall comply with all the legal requirements in the matter of employment of workmen and provide all safety gadgets to the workmen while working in the hazards place or conditions during the execution of the contract.

13. Contractor shall be fully responsible in the event of death of employee / workman during the execution of the work and liable to pay adequate compensation to the dependents of employee/ workman as per law.

14. On his / their failure, if the Board is made to pay compensation the same shall be recovered by the Board from the contractor out of the amounts due to the contractor or by appropriate legal action.

15. If death of any employees occurs during execution of work due to negligence of contractor, the contract will be liable for termination.

16. In the event of such termination, the employer may consider blacklisting of firm after due notice.

17. In case of any death or accident the contract will be cancelled after following due process.

    a) The Board will be entitled to claim exemplary damages from the contractor in case of death of any work man / employees of the contractor in any of the BWSSB works as it damages the reputation of the Board.

18. The Bidder Should not have applied for or are now part of Corporate Debt Restructure (CDR) / SDR in the last 5 Financial Years.
19. The Contractor shall use tertiary treated water from BWSSB for Construction, Flow testing at the prevailing rates of BWSSB.
20. The Supply of pipes and other materials shall be initially for only 50% of the quantity of BOQ is considered and further supply will be as per the recommendations of the Engineer In-charge based on the requirement.
21. All required permissions/ROW issues from all concerned departments such as NHAI / Railways / any other department shall be obtained from the contractor and Board Engineers will assist for the same. Deposits payable to the departments will be borne by the Board.
22. No Variation work will be executed by the firm unless approval is conveyed from the Competent Authority.
23. The Hard Rock obtained during execution, will not be auctioned by Board (Because of the restriction in stocking of hard rock in site and safety issues). However Rs.70.00 per cum + applicable GST of Hard Rock will be recovered from the firm in Running bills.
24. Designated qualified safety officer/Engineer shall be deployed at site from the firm.
25. The estimate for the above work is prepared excluding GST.
26. The contractors are being informed to quote their rate excluding GST. The GST, at the prevailing rate will be paid.
27. The Contractors shall carry out the above work considering the exsiting water supply alignment and transmission line.
28. The Tenderer should have not been black listed by any Central / State Government Institutions in last 3 Financial Years. An undertaking (Self-Certificate) in this regard that the bidder hasn’t been blacklisted by any Central / State Government Institution must be submitted.
29. Tenderer should inspect the site to know the existing Utilities if any before quoting.

30. The Bidder should not have incurred losses for more than 2 years in last Five financial years.
31. The Tenderer should upload the notarized copy of the Certificates. If the certificates are found to be not genuine, action will be taken on such tenderer and will be Black listed.
32. In respect of Conditions of Contract of Section-C-Quality Control, Clause.35 of 35.1 under Payments for Variations for upto 125% of BOQ- The BOQ rates is compared with SR of year of award plus TP rates and lesser among them is considered for quantities exceeding 125% of BOQ in the work slip.
33. The “As-built” drawing (in scale 1:100) in 2 sets need to be submitted both in hard copy and soft copy for approval within 30days before issue of certificate of completion of work by incorporating/updating in the GIS countersigned by PMC and BWSSB officials. The soft copy shall be provided in 1TB-SSD
34. The contractor shall visit the site before attending the pre-bid meeting. The queries received after pre-bid meeting will not be entertained.
35. As per Conditions of Contract under Clause-18 of Approval by the Employer- The contractor has to carry out the survey, geotechnical and submit the drawing related to GLR, pumping station with alignement as per the scope of work. After the verification and concurrence of the PMC, Contractor has to submit 6 sets of drawings for approval. The distribution of drawings by the employer as below:
    PMC- 1set.
    Employer-4 Sets
    Contractor- 1set.
36. In case of any death or accident the contract will be cancelled after following due process:

    1) Any utilities encountered during execution if damaged by the contractor, the same need to be rectified immediately without any delay at his own cost with due approval from the concerned.
    2) If any undue incidents with respect to non compliance to safety at site per decease, the contractor has to pay Rs. 10.00 Lakh immediately, failing which the Board will pay and the same will be recovered by the contractor.

37. Restrictions on public procurement from bidders of certain countries- The procurement of spare parts and other essential service support like Annual Maintenance Contract(AMC)/ Comprehensive Maintenance Contract (CMC), including consumables for closed systems, from original Equipment Manufacturers (OEMS) or there authorized agents, shall be exempted from the requirement of registration as mandated under Government order No. FD 455 Exp-12/2020, Bengaluru, dated: 28.8.2020.

38. Hydro testing and water required for hydrotesting shall be responsible of contractor.

39. M30 concrete BOQ rate shall as to be withheld by 5% till completion of hydrotesting.

SECTION 6:

CONTRACT DATA

CONTRACT DATA

Items marked "N/A" do not apply in this Contract.

The following documents are also part of the Contract: Clause Reference

1 • The Schedule of Operating and Maintenance Manuals [48]
2
3 • The Methodology and Program of Construction [25]

4 • Site Investigation Reports [14]
5
6 • The Schedule of Key and Critical Equipment to be deployed on the work as per agreed program of construction. [25]

The Employer is :

Name: ***Chief Engineer (Project), BWSSB.*** [1.1]

Address: 3rd ***Floor, Cauvery Bhavan,***
Kempegowda Road,
Bangalore 560 009
Ph: 080-22945108

Name of authorized Representative: ***Executive Engineer (P)-4 Division***
Anandarao circle,
Bangalore.

The name and Identification number of the Contract is : The work construction of 13.5 ML GLR at Kalkere and pumping station at Rammurthy nagar

The Works involves Survey, detail geo technical investigations, Construction, hydraulic testing, commissioning of 13.5 ML Capacity GLR ,with pumping station and allied works.

The start date shall be the date of issue of notice to proceed with the work. [1.1]

The Intended Completion Date for the whole of the Works is **Eighteen (18) *Months***[7] with the following milestones [17, 26]

Milestone dates:

	Physical works to be completed	**Period from the date of issue of Notice to proceed with the work**	**Remarks**
Milestone-1 duration	Completion of 100 % sub structure /Foundation	10 months from the date of agreement.	If the Milestone is

[7] Fill in the exact date of completion at the time of agreement

	works. Commencement of Super structure works of GLR, and security room building .		not achieved within the time period, 5% of the cost of Milestone shall be withheld and will be released after achieving the target within the tender period. If the delay is attributed to the Contractor, as per the tender clause, the amount withheld will be adjusted for the delay damages to be levied.
Milestone - 1value in Rs-	5.42 crores		
Milestone-2 duration	Completion of structural works of GLR. Works of pumping station and works.	Fifteen months from the date of agreement.	
Milestone - 2 value in Rs-	8.33 Cr		
Milestone-3 duration	100% Completion of all works, with testing and commissioning.	Eighteen months for the date of agreement.	
Milestone - 3 value in Rs-	10.47 Cr		

The Site Possession Date is: **After Issue of work order** [21]

The Site is located at Kalkere and Rammurthy nagar. [1.1]

Defects Liability Period is 365 days. [31]

Insurance requirements are as under: [13]

	Type of Cover	Minimum cover for Insurance
(i)	Works and of Plant and materials	The sum stated in the Agreement plus 20%
(ii)	Loss or damage to equipment	Full replacement cost
(iii)	Loss or damage to property of Third Party	Full replacement cost
(iv)	Personal injury or death insurance (a) for Third Party	Rs. 25.00 Lakhs
	(b) for Contractor's employees or labour	In accordance with the statutory requirements applicable to Karnataka

Payment Terms.

The employer will make the payment to the items on the following terms

For DI, MS Pipelines, Valves and Electro Mechanical Equipments and Specials

60% of the contract price	After supply of Materials
20% of the contract price	After laying/installation of Materials.
10% of the contract price	After certification of Hydraulic/Electrical testing.
10% of the contract price	After Completion and commissioning of Works.

Valves, Air-Valves.

75% of the contract price	After supply of Valves to site of work
20% of the contract price	After fixing in pipeline.
5% of the contract price	After successful completion of work

Steel Reinforcement for R.C.C work

75% of the contract price	After Supply of Steel to site of work.
25% of the contract price	After steel bending & binding at site of work.

Water Retaining M30 RCC Structures

95% of the contract price	After Completion of Respective items of works as per BoQ.
5 % of the contract price	After successful testing & commissioning of works.

Price Adjustment Formula [40]

R =Value of work as defined in Clause 40.1 of Conditions of Contract.

Adjustment for cement component

(i) Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula.

$V_c = 0.85 \times P_c/100 \times R \times (C_i - C_o)/C_o$, Where

V_c = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for cement

C_o = The all India average wholesale price index for **Ordinary Portland** for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi.

C_i = The all India average wholesale price index for **Ordinary Portland** for the quarter under consideration as published by Ministry of Industrial Development, Government of India, New Delhi

P_c = Percentage of cement component of the work

Note: *Index for all types of cement shall be considered from Cement –Group provided in the web site www.eaindustry.nic.in.*

Adjustment for steel reinforcement component

(ii) Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula:

$V_s = 0.85 \times P_s/100 \times R \times (S_i - S_o)/S_{o,}$ where

V_s = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for steel

S_o = The all India average wholesale price index for steel (**MS Steel long products**) for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

S_i = The all India average wholesale price index for steel (**MS Steel long products**) for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_s = Percentage of steel reinforcement component of the work

Note: For the application of this clause, index of **MS Steel long products** has been chosen to represent steel group for general construction.

Adjustment of DI Pipes component

(iii) Price adjustment for increase or decrease in the cost of DI Pipe shall be paid in accordance with the following formula:

$V_b = 0.85 \times P_{di}/100 \times R \times (D_i - D_o)/D_{o,}$ where

V_b = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rate for Pig Iron.

D_o = The all India average Whole Sale price index of Pig Iron on the day 30 days prior to date of opening of Bids.

D_i = The all India average Whole Sale price index of Pig Iron of the quarter under consideration.

P_{di} = Percentage of DI pipe component of the work.

Note: For the application of this clause, index of **Pig Iron** has been chosen.

Adjustment for MS pipe component

(iv) Price adjustment for increase or decrease in the cost of steel procured by the Contractor shall be paid in accordance with the following formula:

$V_s = 0.85 \times P_{ms}/100 \times R \times (S_i - S_o)/S_{o,}$ where

V_s = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for steel

S_o = The all India average wholesale price index for steel **(Hot Rolled (HR) Coils & Sheets, including Narrow Strip)** for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

S_i = The all India average wholesale price index for steel **(Hot Rolled (HR) Coils & Sheets, including Narrow Strip)** for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_{ms} = Percentage of MS pipe component of the work

Adjustment for labour component

(v) Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula:

$V_L = 0.85 \times P_l/100 \times R \times (L_i - L_o)/L_o$ Where,

V_L = increase or decrease in the cost of work during the quarter under consideration due to changes in rates for local labour.

L_o = the average consumer price index for industrial workers for Bangalore centre for the quarter preceding the date of opening of Bids as published by Labour Bureau, Ministry of Labour, Government of India.

L_i = The average consumer price index for industrial workers for Bangalore centre for the quarter under consideration as published by Labour Bureau, Ministry of Labour, Government of India.

P_l = Percentage of labour component of the work.

Adjustment of POL (fuel and lubricant) component

(vi) Price adjustment for increase or decrease in cost POL (fuel and lubricant) shall be paid in accordance with the following formula:

$V_f = 0.85 \times P_f/100 \times R \times (F_i - F_o)/F_{o,}$ where

V_f = Increase or decrease in the cost of work during the quarter under consideration due to changes in rates for fuel and lubricants.

F_o = The average official retail price of High Speed Diesel (HSD) at the existing consumer pumps of IOC at Bangalore on the day thirty days prior to the date of opening of Bids.

F_i = The average official retail price of HSD at the existing consumer pumps of IOC at Bangalore for the 15th day of the middle calendar month of the quarter under consideration.

P_f = Percentage of fuel and lubricants component of the work.

Note: **For the application of this clause, the price of High Speed Diesel oil has been chosen to represent fuel and lubricants group.**

Adjustment for Plant and Machinery Spares component

(vii) Price adjustment for increase or decrease in the cost of plant and machinery spares procured by the Contractor shall be paid in accordance with the following formula:

$V_p = 0.85 \times P_p/100 \times R \times (P_i - P_o)/P_{o,}$ where

V_p = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for plant and machinery spares

P_o = The all India average wholesale price index for (Manufacture of Machinery and Equipment) for the quarter preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

P_i = The all India average wholesale price index for (Manufacture of Machinery and Equipment) for the quarter under consideration as published by Ministry of Industrial Development, New Delhi

P_p = Percentage of plant and machinery spares component of the work

Adjustment for Other materials

(viii) Price adjustment for increase or decrease in the cost of other materials other than cement, steel, bitumen and Fuel and Lubricants procured by the contractor shall be paid in accordance with the following formula:

$V_M = 0.85 \times P_M/100 \times R \times (M_i - M_o)/M_{o,\ Where}$

V_M = Increase or decrease in the cost of work during the quarter under consideration due to changes in the rates for local materials other than cement, steel, bitumen and Fuel and Lubricants.

M_o = The all India average wholesale price index for all commodities for the quarter preceding the date of opening of bids, as published by the Office of the Economic Advisor, Ministry of Commerce and Industry, Government of India, New Delhi.

M_i = The all India average wholesale price index for all commodities for the quarter under consideration, as published by the Office of the Economic Advisor, Ministry of Commerce and Industry, Government of India, New Delhi

P_M = Percentage of other materials (other than cement, steel, bitumen, DI pipes and Fuel and Lubricants) of the work

The following percentages will govern the price adjustment for the entire contract:

1.	Cement - P_c	**% will be informed during agreement**
2.	Steel Reinforcement - P_s	**-Do-**
3.	DI Pipe – P_{di}	**-Do-**
4.	MS Pipe – P_{ms}	**-Do-**
5.	Labour – P_l	**-Do-**
6	Fuel & Lubricants - P_f	**-Do-**
7	Plant & Machinery Spares - P_P	**-Do-**
8	Other Materials-Pm	**-Do-**
	Total	100%

The liquidated damages for the whole of the works are
Rs. ***0.1%*** per day of the contract value and that for the milestones are as under:

The maximum amount of liquidated damages for the whole of the works is ten percent of final contract price. [41]

Nature of Advance	Amount (Rs.)	Conditions to be fulfilled
Installment of Mobilization	5% of the Contract price	On submission of un-conditional Bank Guarantee. (to be drawn before end of 20% of Contract price)

Repayment of advance payment for mobilization: [42]
The advance loan shall be repaid with percentage deductions from the interim payments certified by the Engineer under the Contract. Deductions shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less than 15 percent of the Contract Price or 6 months from the date of payment of first installment of advance, whichever period concludes earlier, and shall be made at the rate of 7.5 percent of the amounts of all Interim Payment Certificates until such time as the loan has been repaid, always provided that the loan shall be completely

repaid prior to the expiry of the original time for completion pursuant to Clauses 17 and 26.

The date by which “as-built”drawings (in scale **1:100**) in 2 sets are required is within 30 days of issue of certificate of completion of Whole or Section of the Work as the case may be. [48]

The amount to be withheld for failing to supply “as built” drawings by the date required is Rs. 2,00,000/- [48]

The following events shall also be fundamental breach of the contract :[49.2]

1. The contractor has contravened Sub-clause 7.1 and Clause 9 of CC.

The percentage to apply to the value of the work not completed representing the Employer's additional cost for completing the Works shall be ***30*** percent. [50.1]

SECTION 7:

TECHNICAL SPECIFICATIONS

Specifications as per relevant IS codes and Bill Of Quantities

I. GENERAL

1.1 Scope of Work.

The Works involves Survey, detail geo technical investigations, Construction, hydraulic testing, commissioning of work of construction of Construction of 13.5 ML GLR at Kalkere with pumping station at Rammurthy Nagar.

a. Providing, laying, jointing, testing and commissioning of all inlet/outlet pipe lines to the GLR with supporting civil, electro-mechanical and instrumentation apparatus and accessories.

b. Scope of work shall also include liasoning with KPTCL/BESCOM for getting construction power supply, making new permanent power supply arrangement for the plant, coordinate with concerned authorities for carrying out the electrical works and getting final clearance from CEIG for complete Electrical system.

c. Procure, install, test and commissioning of the pump sets with motors, valves and other accessories.

d. Procure, install, test and commissioning of the electrical and instrumentation equipments and other accessories

e. The CONTRACTOR shall be deemed to have visited and carefully examined the site and surroundings and to have satisfied himself about the nature of the existing structures, general site conditions, the site for disposal of surplus materials, debris etc.(The useful and un-useful surplus materials out of site grading / excavation shall be dumped in their respective specified dump areas) and all other items affecting the work. Claims due to ignorance of site conditions will not be considered after submission of the Bid.

f. The Contractor shall, at his own cost, conduct tests, to ensure the suitability of the proposed fill material. He shall submit the test results to the Owner/Consultant and obtain approval of the same before commencing the site grading operations, and, if required shall make arrangements for the Owner/Consultant to witness sample preparation and conducting of the tests.

1.2 Royalties

1.2.1 The Employer shall deduct Royalties on materials used in the Works from the progress payments to the Contractor at the rates specified in the most recent “Amendment to the Karnataka Minor Minerals Concession Rules - 1969” as published by the Commerce and Industries Department (Mines) and as illustrated in Annexure-1, attached.

1.3 Site Order Book

1.3.1 The Contractor shall maintain an identical pair of Site Order Books (one marked original and the other marked duplicate), at the Site at all times during the execution of the Works for the use of the Engineer and the Contractor. All instructions issued by the Engineer to the Contractor shall be recorded in both sets of the Site Order Book and shall be signed by the issuer and countersigned by the Contractor. After compliance with the instruction, the Contractor shall record the same in both sets of the Site Order Book duly signed and countersigned by the Engineer. Acceptance of any part of the work executed by the Contractor shall be subject to verification with respect to compliance of respective instructions of the Engineer through the Site Order Book. The Engineer shall retain the original copy of the Site Order Book, while the Contractor shall retain the duplicate one.

1.4.1 General Design Criteria

a) The design standards described herein are generally in compliance with the latest Indian Standards, and code of practices already established in the country.

b) All electrical installations shall conform to the latest Indian Electricity Acts and Rules.

c) All electrical equipment shall be rated for 45 ^{0}C design ambient temperature.

d) System Details

LV System

(i) Voltage : 415 V nominal
(ii) Frequency : 50 Hz
(iii) Connection : 4 wire
(iv) No load transformer voltage : 433 V
(v) System earthing : Solidly earthed

AC Control, Lighting and Space Heating

(i) Voltage : 240 V
(ii) Phases : 1
(iii) Frequency : 50 Hz
(iv) Connection : 2 wire (Phase & Neutral).

Pumping Station shall, unless otherwise specified, be capable of continuous operation at a voltage level in the range of 90% to 110% of the relevant nominal voltage and a frequency variation of ±5% with a maximum combined tolerance of 10%.

e) System Protection

Transformer Protection

- Winding Temperature High Alarm;
- Oil Temperature High Alarm;
- Buchholz Relay Alarm;

415 V Incomer Feeders

- Over current & Earth fault protection;
- Under voltage relay;

415 V Incomer Feeders

- Over current & Earth fault protection;
- Under voltage relay;

LV Motors

Motors less than 15 kW	**Motors 15 kW up to 112kW**	**Motors of 125kW and up to 250kW**
Motor Protection Circuit Breaker with Overload protection + Short circuit protection	MCCB with thermal magnetic based Overload & short circuit release	MCCB with thermal magnetic based Overload & short circuit release
Single phasing preventer	Phase currents out of balance	Locked rotor
	Single phasing preventer	Phase Over current (50/51);
		Earth fault (50N/51N);
		Over voltage & under voltage
	Separate bimetallic overload relay	Phase loss/reversal
		Negative sequence
		Protection for repeated and prolonged starts
		Restart inhibition
		Single phasing preventer

f) Switchgear Instruments

415V PCC Incomer	**415V Floor Mounted Starter Panels**
Analog Ammeter with Selector Switch	Analog Ammeter with Selector Switch

Analog Voltmeter with Selector Switch	DOL Starters for motor feeders less than or equal to 5.5 kW.
MFM	Star-Delta Starters for motor feeders above 5.5 kW and upto 112 kW.
	Line/Neutral Soft Starters for motor feeders above 112 kW.

g) Pumping Station Equipment & Design Considerations

11kV Outdoor Load Break Switch (LBS) Panel

11kV Outdoor Load break panel shall be outdoor, floor standing, sheet metal enclosed with IP55 degree of protection, with load break switch and HRC fuse for incoming & outgoing feeders. The panel shall be rated for a fault current not less than 26.3 kA (rms).

Distribution Transformer

The transformer shall be out door type, ONAN, 11/0.433 kV, 3 phase, 50 Hz, two winding, Dyn11 with solidly earthed neutral.

The transformer shall be sized considering 10% contingency of total working load while arriving at the final capacity of transformers. The transformer shall be designed such that at any point of time maximum loading on transformer shall not exceed 85% of full load capacity.

415 V Outdoor LT Kiosk

LT Kiosk shall be outdoor type with 4P, ACBs/MCCBs located in the transformer yard. The outdoor LT Kiosk shall have a minimum IP-55 protection.

Operation Logic of Switchgears

Under normal condition, the entire plant shall be fed from the Grid Mains. The transformer Incomer-1 & 2 closed and Bus-Coupler open. Failure of any transformer incomer, faulty incomer will be open and bus-coupler will be closed and power supply shall be fed from healthy incomer.

415 V PCC/MCC Panels & Floor Mounted Starter Panels

415 V PCC/MCC shall be floor standing, sheet steel enclosed with IP 54 Degree of Protection, Form – IV enclosure as per IS 8623 complete with Air circuit breakers/MCCB’s/MPCBs, Control & Protection. The panels shall be rated for a fault current not less than 25 KA (rms) for 1 sec.

LV Capacitor Bank & Power Factor Correction

The capacitor banks provided shall be of bus connected type with Automatic Power factor correction, the system shall be designed such that a power factor of not less than 0.95 is maintained.

Automatically controlled multistage power factor correction (PFC) with not less than 8 No. of PFC stages per panel shall be provided & connected to bus section of the LT PCC. The power factor on bus section of the board shall be monitored and corresponding PFC capacitors switched in and out automatically in discrete stages in order to maintain a set point PF value.

MCCBs, Switches, Contactors shall be suitable for making and breaking current of the capacitors. The Panels shall be floor standing, sheet steel enclosed with IP 54 degree of Protection.

HV Power Cables

HV cables shall be 3 core, 11kV (E), XLPE type with stranded aluminum conductors & GI armouring. Minimum size of cable shall be selected based on the short circuit considerations.

LV Power Cables

LV power cables shall be 1.1 kV, XLPE insulated, PVC Sheathed GI steel wire/strip armoured with

Al conductor - for sizes greater than 6 sq.mm

Cu conductor - for sizes upto 6 sq.mm

No. of cores shall be as per requirement.

Control Cables

Control cables shall be 650/1100V, stranded copper conductors and GI armouring. No. of cores shall be as per requirement. Minimum size of core shall be 1.5 Sq.mm.

Cable Rating

All power cables shall be sized for continuous current carrying capacity and permissible voltage drop at an ambient temperature of 45 ^{0} C. Due consideration shall be taken of cable grouping, method of installation and local variations in ambient conditions. Further, for cables controlled by circuit breakers, due consideration shall be given to the fault level.

HV and LV cables shall be sized for a minimum fault clearance time of 1 second for incoming feeders, 0.5 seconds for tie feeders & and 0.16 second for equipment feeders.

For all LT Cables, the voltage drop in the cables between the transformer and the switchgear (PCC/Main LT Panel) or between PCC and MCC for full load current shall be limited to 2%. Further the voltage drop in cables between PCC/MCC to Motor terminals for full

load current shall be limited to 3%. The total Voltage drop transformer secondary to motor terminal shall be limited to 5%.

Under motor starting conditions the corresponding voltage drop shall not affect the operation of the motor controls or the ability of the motor to start and run effectively and in any event shall not exceed 15%.

Lighting

All internal and external areas shall be provided with **LED lighting**. The illumination levels to be achieved shall be as follows:

Area	**Illumination Level (Lux)**
Pump house	250 Lux
Switchgear/Electrical room	250 Lux
Building entrance/Periphery lighting	100 Lux
Outdoor transformer yards & road lighting	20 Lux

Luminaries for internal & external lighting shall of LED type. The outdoor lighting fittings shall be weatherproof, dustproof and corrosion resistant with IP65 protection class.

The lighting installations shall be designed using a maintenance factor of 0.8 for indoor and 0.7 for outdoor. Outdoor/ street lighting shall be provided with photocell & timer controls, with manual override facilities.

Octagonal poles of minimum 7m / 8m shall be used for road lighting.

Rechargeable emergency lamp (600 mm fluorescent lamp) or LED lamps shall be provided for all indoor rooms near door exits. These lamps shall illuminate automatically in case of power failure.

Wiring: Lighting for indoor high/low bay luminaries & external areas shall be done with multicore armored cable. Junction boxes shall be used for looping.

Lighting in other internal areas shall be provided with 2.5 sq.mm PVC insulated 1100V grade, copper conductor single core cable.

Small Power Outlets

Switched single phase three pin, 5A/6A and 15A/16A receptacles shall be provided throughout. In offices and control rooms they will be the decorative type and industrial type in all other areas.

Switched three phase and neutral industrial receptacles (63A) will be provided in plant for welding purposes. Receptacles for outside areas will have a degree of protection of IP 55.

Ventilation

Exhaust fans will be provided in switchgear rooms as per requirement & ceiling fans will be provided in offices, control rooms. The supply to these fitted ceiling fans shall be provided from the local lighting circuit.

Earthing System

a) An earthing system network comprising earth electrodes and conductors will be established at each substation/transformer yard and at the pumping station. The two networks shall be interconnected.

b) The earthing system shall be designed to give a combined earth resistance value of not greater than 1 ohm. In order to be sure of obtaining suitable final values, soil resistivity shall be measured at the various sites during the detail design phase of the work.

c) In outdoor substation areas the main earth electrode conductors will be located, to ensure potential gradients occurring at the surface during fault conditions are kept within allowable limits.

d) Materials used for earth electrodes shall be designed to suit the ground conditions and could either be plain mild steel or copper coated steel.

e) The system shall be designed for the following maximum earth fault currents.

- 11 kV system 26.3 kA
- 415 V system 25 kA

f) The fault clearing time shall be taken as one second the 11 kV and 415 V systems.

g) The maximum temperature allowed for steel welded joints will be taken as 500 0C with an ambient of 45 0C. Main equipotential bonding conductors will be galvanized steel.

h) Circuit protective conductors will comprise either the armouring of the supply cable or, for major loads such as main switchboards and large drives the supply cabling plus an additional suitably sized single core copper cable.

i) The neutral point of the 11/0.433 kV transformer secondary windings will be solidly earthed.

j) Transformer & DG set shall be provided with 2 nos. of dedicated earth pits for neutral.

Lightning Protection System

a) The need of lightning protection shall be established by calculating the overall risk factor as per IS/IEC 62305 for the entire GLR/OHT/pumping station campus.

b) Air termination system comprising of rods/mesh or combination of both shall be provided and the methods used to determine the positioning of Air termination system shall be as per IS/IEC 62305.

c) Air termination system shall be connected to the earthing system by down conductors fixed along the outer surface of building. Number & layout of the down conductors will be as per IS/IEC 62305.

d) Each down comer will be terminated to a separate treated test earth electrode which in turn will be connected to station earthing system.

e) Test link will be provided in the run of each down conductor at approximately 1000 mm above ground level.

f) Supply and Installation of class 1 & 2 Surge Protection Device (SPD) to arrest surges and over voltages in the power line due to lightning switching action etc. They must be installed in the incoming MCC panel/ DB of the respective building in parallel to the building power circuit.

1.4.2 Specific Requirements of 11kV Load Break Switch (LBS) Panel

11kV Outdoor LBS shall be outdoor, floor standing, sheet metal enclosed with IP55 degree of protection, with load break switch and HRC fuse for incoming & outgoing feeders. The panel shall be rated for a fault current not less than 26.3 kA (rms). LBS should have the following:-

(i) Manually operated 12 kV, 630A Load Break switch and Earthing Switch of required making capacity. The earth switch shall be naturally interlocked to prevent the main and earth switch being switched ‘ON’ at the same time.

(ii) Each load break switch shall be of the triple pole, simultaneously operated, non automatic type with quick break contacts and with integral earthing arrangement.

(iii) The rated current of Isolator shall be 630 Amps continuous at maximum ambient temperatures. No derating shall be allowed.

(iv) The operating mechanism shall be spring assisted mechanism with operating handle for ON/OFF. Earth positions with arrangement for padlocking in each position. Also independent manual operations with mechanically operated indicator.

(v) Three nos. of continuous Bus bars made up of EC grade tinned copper of rating current 630A shall be provided. The Short time rating current shall be 20 kA for 3 seconds for 11 kV and 16 kA for 3 seconds for 22 kV. The Busbar connections shall Anti- oxide greased.

(vi) "Live Cable" LED Indicators thru Capacitor Voltage Dividers mounted on the bushings.

(vii) Mechanical ON/OFF/EARTH Indication.

(viii) Anti-reflex operating handle.

(ix) Cable Testing facility without disconnecting the cable terminations, cable joints and terminal protectors on the bushings.

(x) Cable boxes suitable for termination of 11kV, XLPE Armoured Cable with right angle Cable Termination Protectors. The cable box shall be arc resistant as per IEC 62271-200 amended up to date.

(xi) The clearance between phase to phase and phase to earth shall be as per IEC 61243 –5 amended up to date. The cable termination and gland arrangements shall be appropriate for the type and style of cables used at the time.

(xii) Panel shall be free standing, sheet steel enclosures suitable for installation in outdoor.

(xiii) The internal arc fault test on cable box shall be carried out for 11 kV system for 20 kA for 1 second and for 22 kV system for 16 kA for 1 second.

(xiv) The internal wiring shall be carried out using multi-strand copper conductor super flexible PVC insulated wires of 1.1 KV Grade for AC Power, DC Control and CT circuits. Suitable coloured wires shall be used for phase identification and interlocking type ferrules shall be provided at both ends of the wires for wire identification. Terminal should be suitably protected to eliminate sulphating. Connections and terminal should be able to withstand vibrations. The terminal blocks should be stud type for controls and disconnecting link type terminals for CT leads with suitable spring washer and lock nuts.

(xv) The Load break isolators, M.S. Channels / M.S. Angles etc, shall be equipped with an earth bus securely fixed along the base of the panel. The earth bus shall be made continuous and necessary connectors and clamps shall be included in the scope of supply. The size of earth busbar of tinned copper flat shall be as per IEC/IS standards and shall be fixed inside the panel. Provision shall be made on end of panel for connecting the earth bus to the earth grid by erecting suitable 2 earth pipes of 40mm diameter

MS rod of 3 meters in pits. Both the earth pipes are also to be connected in a grid formation. Necessary terminal clamps and connectors shall be included in the scope of supply.

(xvi) All drawings shall conform to relevant IEC Standards Specification. All drawings shall include dimensional general arrangement drawings of the equipments, illustrative and descriptive literature which is all essentially required for future automation.

a) Schematic diagram of the LBS panel.

b) Instruction manuals.

c) Catalogues of spares recommended with drawing indicating each items of spares.

d) List of spares and special tools recommended by the supplier.

e) Copies of Type Test Certificates as per latest IS/IEC.

f) Drawings of equipments, relays, control wiring circuit, etc.

g) Foundation drawings.

h) Dimensional drawings of each material used for item.

i) Actual single line diagram of LBS panel.

1.4.3 Specific Requirements of 11kV Vacuum Circuit Breaker (VCB) Panel

11kV Vacuum Circuit Breaker (VCB) panel shall be outdoor, floor standing, sheet metal enclosed with IP55 degree of protection, with VCB for incoming & outgoing feeders. The panel shall be rated for a fault current not less than 26.3 kA (rms). VCB panel shall have the following:-

(i) The VCBs shall be maintenance free and shall have three positions (or states), i.e., Open, Closed, and Earthed, and shall be constructed in such a way that natural interlocking prevents unauthorized operations. They shall be fully assembled, tested, and inspected in the factory.

(ii) An operating mechanism shall be used to manually close the Circuit Breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping. There shall be no automatic reclosing. The Circuit Breaker shall be capable of closing fully and latching against the rated making current. Mechanical indication of the OPEN, CLOSED, and EARTHED positions of the Circuit Breaker shall be provided.

(iii) When the Circuit Breaker closing mechanism is of the spring operated type, it shall not be possible for the Circuit Breaker to close until the spring is fully charged and the associated charging mechanism is fully ready for closing. Wherever an external spring charging handle is required to charge the spring, it shall be ensured that the same is not allowed to move during release of the spring energy. Alternatively, it shall not be possible to release the spring energy until the charging handle is completely disengaged from the mechanism.

(iv) A visual mechanical indicating device shall be provided to indicate the status of the spring, i.e., SPRING CHARGED or SPRING DISCHARGED. It shall be possible to charge the spring when the Circuit Breaker is closed and, if the spring is released, the Circuit Breaker shall not open. Nor shall this operation result in any mechanical damage to the component of the Circuit Breaker or its operating mechanism. Alternatively, a fast acting reflex mechanism for Circuit Breakers is also acceptable.

(v) Each Circuit Breaker shall operate in conjunction with a suitable protection relay under lateral circuit phase and earth fault conditions.

(vi) The VCB panel shall be equipped with numerical relays for over current (OC) and earth fault (EF) protection as used to trip the circuit breakers.

(vii) VCBs shall be provided with all interconnecting wires, cables, connectors, terminations and other wiring accessories such as terminal blocks.

(viii) VCB panel shall be equipped with control transformer for providing 230V AC supply.

(ix) VCB panel shall be provided with the following monitoring and control features:

- Positions of local/remote switches as used to control local and remote access to circuit breakers.
- Open/closed position of circuit breakers, and earthing switches.
- Enclosure door-open indications.
- SF_6 gas-pressure low alarm.
- Circuit breaker spring charge (breaker readiness) indications.
- Circuit breaker relay indications.
- Measurement of 11 kV voltage, current, power, energy, and power factor values.
- Circuit breaker open/close control.

- Relay settings control.

(x) The VCB panel shall be suitable for mounting on its connecting cable trench.

(xi) There shall be continuity between metallic parts of the panel and cables so that there is no dangerous electric field in the surrounding air and the safety of personnel is ensured. The panel frames shall be connected to the main earth bars, and the cables shall be earthed by an Earthing Switch having the specified short circuit making capacity. The earthing Switch shall be operable only when the main switch is open. In this respect, a suitable mechanical fail-proof interlock shall be provided.

1.4.4 Specific Requirements of 415V LT Panels

These specifications are applicable to 415V LT Panels, Power Control Centres (PCCs), Motor Control Centres (MCCs), Floor mounted starter panels, Power Distribution Boards etc.

a) General construction features

(i) Sheet steel used for fabrication of panel shall be cold rolled.

(ii) Panel shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled sheet steel of thickness not less than 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.

(iii) All doors, removable covers, gland plates etc. shall be of at least 1.6 mm thickness and shall be gasketedall round the perimeter.

(iv) All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

(v) Total height of all floor mounted cubicles/panels shall not be greater than 2300 mm.

(vi) Degree of protection of the enclosure shall be IP 54 for indoor and IP 55 for outdoor installation.

(vii) Operating devices shall be incorporated only in the front of switchgear.

(viii) Each shipping section shall have metal sheets at both ends.

(ix) Cable alley shall be provided with suitable hinged doors.

(x) GI Earth bus of size 50mm x 10 mm shall be provided at the bottom.

(xi) Rear side of Switchgear shall be provided with removable panels with screws.

(xii) All doors shall be with concealed type hinges and captive screws

(xiii) Each vertical section shall be equipped with 240 V, 1 Phase, and 50 Hz space heater controlled by thermostat.

(xiv) A 240 V, 1 phase, AC plug point shall be provided in the interior of each cubicle with on-off switch for correction of head lamps.

(xv) All indoor panels shall be suitable for bottom entry of cables.

(xvi) R, Y, B indications with cluster type LEDs shall be provided for all incomers.

(xvii) Control transformer of required rating shall be provided for providing single phase AC supply.

(xviii) All incomer MCCBs shall be provided with ON/OFF/Trip indications and all incomer ACBs shall be provided with ON/OFF/Trip/Spring Charged indications.

(xix) All outgoing feeders shall be provided with ON/OFF/Trip indications.

(xx) All motors starters shall be provided with Auto/Manual Selector switch, Start & Stop Push buttons.

(xxi) Incomer ACBs/MCCBs of Main LT Panel/PCC shall be provided with electronic based overload, Short circuit and earth fault releases.

b) Moulded Case Circuit Breaker (MCCB):

(a) MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing. MCCBs shall have an ultimate short circuit capacity (I_{CU}) not less than the short circuit current (I_{CS}) specified. MCCBs shall have a service $I_{CS} = I_{CU}$.

(b) Each pole of MCCB shall be fitted with a bi-metallic thermal element for inverse time delay protection and a magnetic element for short circuit protection. Alternatively, they shall be fitted with a solid state protection system. Such a protection system shall be fully self-contained, needing no separate power supply to operate the circuit breaker tripping

mechanism. Thermal element shall be adjustable. Adjustments shall be made simultaneously on all poles from a common facility. Thermal elements shall be ambient temperature compensated.

(c) The MCCBs shall be provided with the following features.

- Common trip bar for simultaneous tripping of all poles
- Shrouded terminals
- Time for clearing short circuit current of 20 msec.
- 2 NO + 2 NC auxiliary contacts
- Extended rotary handle with pad lock arrangement.

c) Switches and Fuses

415 V air-break switched shall be of the load break, fault make, group operated type. For use on 3-phase systems, the switches shall be of the triple pole type with a link for neutral wire. For use on single phase system, the switches shall be of the two pole type.

Switches shall be of the heavy duty, quick make and quick break type. Switch contacts shall be silver plated, and contract springs shall be of stainless steel. Switch handles shall have provision for locking in both fully open and fully closed positions. Mechanical ON-OFF indication shall be provided on the switches.

Switches for controlling motor circuits shall be of the load break, fault make type, and shall be capable of breaking locked rotor current of the associated motor.

All DC circuit fuses shall be on both poles and 415 V switches and fuses shall be provided with the following interlocks so that:

- The fuses are not advisable unless the system requires the same.
- It is not possible to close the switch when the cover is open, but an authorized person may override the interlock and operate the switch. After such an operation, the cover shall be prevented from closing if the switch is left in the ‘ON’ position.

Fuse less system shall be provided in case fuses required, fuses shall be of the HRC cartridge type, mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated.

Earthing and neutral lines in main supply circuits shall be of solid silver plated copper and be of the bolted pattern.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

d) Air Circuit Breaker (ACB)

Air circuit breaker shall be selected for feeders for load current equal to and more than 630A.

Circuit breakers shall be operated by a motor spring charging type of mechanism. The motor operated spring charged mechanism shall be complete with motor, opening spring, closing spring and all accessories to make the mechanism a complete operating unit.

The tripping spring shall be charged by the closing action, to enable quick tripping. Closing of the circuit breaker shall automatically initiate recharging of the springs to enable the mechanism to be ready for the next closing stroke. Charging time for the springs shall not exceed 30 seconds. It shall be possible to manually charge the springs in an emergency. Transfer from motor to manual charging shall automatically disconnect the charging motor. The charging mechanism shall be provided with mechanical indicators to show "charged" and "discharged" conditions of the spring. Failure of any spring, vibration or mechanical shock shall not cause tripping or closing of the circuit breaker.

Only one closing operation of the circuit breaker shall result from each closing impulse (manual or electrical), even if the breaker trips while the control device (manual or electrical) is being held in the "close" position.

The circuit breaker mechanism shall make one complete closing operation, once the push button has been operated and the first device in the control scheme has responded, even though the PB is released before the closing operation is complete, subject to the condition that there is no counter- impulse for tripping.

Means shall be provided to manually open and close the breakers slowly, when the operating power is not available, for maintenance and adjustments. A local manual trip device shall be provided on the operating mechanism.

All operating mechanisms shall be provided with "ON" - "OFF" mechanical indication.

i. Closing coils and other auxiliary devices shall operate satisfactorily at all voltages between 85-110 % of the control voltage. Trip coils shall operate satisfactorily between 70 -110 % the rated control voltage.

ii. The Breaker shall be provided with Microprocessor based releases for Inverse-time delayed overload releases for the phases, Short-time delayed short-circuit releases and earth-fault releases.

iii. The breaker service Short Circuit breaking capacity (ICS) shall be equal to ultimate Short Circuit capacity (ICU)and shall be equal to short time withstand current of Breaker (ICW).

e) Miniature Circuit Breaker (MCB)

i. MCBs shall be hand operated, air break, quick make, quick break type.

ii. Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.

iii. Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the connected load. Where this is not specified, it shall be Type C. The short circuit rating shall be not less than that of the system to which they are connected.

f) Contactors

The power contactors used in the switchboard shall be of air break, single throw, triple pole, electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with the latest edition of IS 13947.

Operating coils of all contactors shall be suitable for operation on 240 V, single phase, 50 Hz supply.

Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.

Contactors shall not drop out at voltages down to 70% of coil rated voltage.

Contactors shall be provided with a three element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings.

The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated. Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactor shall all be provided with single phasing preventer (SPP).

g) Current Transformers

(i) Current Transformers shall be Cast Resin type.

(ii) Current transformers shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.

(iii) Current transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary duties of the switchgear, as indicated in the Technical Specification.

(iv) CT core laminations shall be of high grade silicon steel.

(v) Identification labels shall be fitted giving type, ratio, rating, output and serial numbers.

h) Voltage Transformers

(i) Voltage Transformers shall be Cast Resin type.

(ii) Secondary and tertiary windings of voltage transformers shall be rated for a three phase line to line voltage of 110 V.

(iii) It shall be possible to replace voltage transformer fuses easily without having to de-energizer the main bus-bars.

i) Indicating Instruments & Meters

All indication instruments and watt hour meters shall be of the digital type and shall have an accuracy of Class 1.0. Digital type ammeters, voltmeters and multifunction energy meters shall have communication facility (RS-485).

j) Indicating Lights

Indicating lights shall be of the cluster LED type, with low watt consumption. Indicating lamp shall be rated for operation at either 240 V AC or at the specified DC system voltage as applicable. LED shall be provided with translucent lamp covers.

k) Push Buttons

"Start" and "Stop" push buttons shall be coloured green and red respectively. Stop Push Button shall be lockable stay-put type with Mushroom head without key or Emergency push button lockable in OFF position and open able only with key.

l) Safety Arrangements

All terminals, connections and other components, which may be “LIVE” when front access door is open, shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle or

module when any door is opened. Components within the cubicles shall be labelled to facilitate testing.

m) Earthing of Switchboards / Panels:

(i) Each switchboard, control panel, etc. shall be provided with an earth bus bar running along its entire length. The earth bus bar shall be located at the bottom of the board/panel.

(ii) Earth bus bars shall be rated to carry the rated symmetrical short circuit current of the associated board/panel for one second, unless otherwise specified. Earth bus bars shall be properly supported to withstand stresses induced by the momentary short circuit current of value equal to the momentary short circuit rating of the associated switchboard/panel.

(iii) Positive connection of the frames of all the equipment mounted in the switchboard to the earth bus bar shall be maintained through insulated conductors of size equal to the earth bus bar or the load current carrying conductor, whichever is smaller.

(iv) All instrument and relay cases shall be connected to earth bus bar by means of 1100 V grade, green coloured, PVC insulated, stranded, tinned copper, 2.5 sq. mm conductor looped through the case earth terminals.

n) Internal Wiring:

The internal wiring shall be carried out with 650/1100V grade, PVC insulated, stranded conductor wires. The minimum size of conductor for power circuits shall be 4 Sq.mm copper or equivalent size aluminium conductor. Control circuits shall be wired with copper conductor of at least 1.5 Sq.mm.

o) APFC Panel with 415 V Power Capacitors:

(i) The LT capacitor banks provided shall be of bus connected type with Automatic Power factor correction, the system shall be designed such that a power factor of not less than 0.95 is maintained.

(ii) Automatically controlled multistage Power Factor Correction (PFC) with 1 No. PFC panel providing not less than 8 No PFC stages shall be provided and connected to bus of the Main LT panel. The PF of the panel shall be monitored and corresponding PFC capacitors switched in and out automatically in discrete stages in order to maintain a set point power factor value.

(iii) MCCBs, Switches, Contactors shall be suitable for making and braking current of the capacitors.

(iv) Capacitor units shall be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute in accordance with the provisions of the latest edition of IS : 2834.

(v) Capacitors shall be of Mixed Dielectric of polypropylene and paper with internal element fuses. The impregnate shall be non PCB (poly chlorinated biphenyl) oil.

(vi) Capacitor units shall satisfactorily operate at 130% of rated KVAR including factors of overvoltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any overvoltage up to a maximum of 10% above the rated voltage, excluding transients.

(vii) Capacitor unit shall be protected by an HRC fuse suitably rated for load current and interrupting capacity, mounting of the individual fuse may be internal or external to the capacitor case.

(viii) Capacitor Bank Units shall have

(a) Power capacitor enclosed in a metal enclosed cubicle.

(b) Isolating switch.

(c) Contactor with overload element

(d) Auto-manual selector switches.

(e) Red and green cluster LED lights for capacitors ON/OFF indication.

(ix) APFC panels shall be floor mounted suitable for top entry of cables.

p) Independent Floor Mounted Starter Panel

(i) Starter Panel shall be floor mounted suitable for 415V, 3 Phase-Neutral, 50 Hz & bottom entry.

(ii) Starter panels shall be single front, free standing, vertical, Fixed cubical type having hinged access doors with locking type latches.

(iii) Degree of protection for Panel shall be IP54 (minimum) and drives shall have IP 20 protection (Min.).

q) Tests

(i) Switchgear shall be subjected to routine tests & witness test as spelt out in Indian Standards and typical type test certificates shall be made available to EMPLOYER/Employer's Representative .

(ii) All meters and other reference devices used for testing shall have valid calibration from reputed national laboratories/institutes. Inspection by EMPLOYER/EMPLOYER'S REPRESENTATIVE will not be carried out unless the Vendor confirms that calibrated equipment is ready for proceeding with the tests.

1.4.5 Specific Requirements of Transformers

The transformer shall comply with the requirements as per the latest amendments and latest revision of IS 1180: 2014.

A. Features of Construction

a) The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections.

b) All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded.

c) The interior of the tank shall be cleaned by sand blasting and painted with two coats of heat resistant, oil insoluble paint.

d) Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanized.

e) The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

f) Lifting lugs and eyebolts shall be so located that a safe clearance is obtained without the use of a spreader, between the sling and transformer bushings.

g) Transformers shall be provided with fixed type radiators. Fins of the radiators shall not have sharp edges and shall be rounded in shape.

h) The transformer core shall be constructed from high grade, non-ageing, cold-rolled, grain oriented, silicon steel laminations. The steel laminations shall be of "core" type. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connection to the tank.

i) Windings shall be of insulated copper wire or copper strip. Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core. The windings shall be fully shrunk under vacuum before assembly. High voltage end-windings shall be suitably braced to withstand short circuit stresses and stresses caused up by surges.

j) The sequence and orientation of HV/LV side phase and neutral bushings shall be as specified in the latest edition of relevant IS.

k) Transformer shall operate without injurious heating at the rated kVA and at any voltage up to + 10% of the rated voltage of any tap. Transformer shall be designed for 110% continuous over-fluxing withstanding capability.

l) Transformer shall be provided with Zero sequence/earth fault current protection on LV side transformer feeder protection. (Neutral CT to be provided in case of solid grounding)

B. Winding connections

Windings shall be of HV: Delta & LV: Star, vector group Dyn11.

C. Rating

The rating of transformers shall be as per standard ratings shown in IS 1180:2014 or relevant standard.

D. Type of cooling

The transformers shall be oil immersed with natural oil circulation, type ONAN.

E. Impedance and losses

The percentage impedance, no load &load losses shall be as per IS 1180: 2014 or relevant standard.

F. Performance requirements

a) The transformers shall be suitable for operation without danger on to any particular tapping at the rated kVA provided that the voltage does not vary by more than ± 10 % of the voltage corresponding to the tapping.

b) The transformers shall be suitable for continuous operation with a frequency variation of ±5% of rated frequency, combined voltage and frequency variation should not exceed 10 %.

c) All transformers shall be capable of withstanding external short circuit without damage as per IS 2026.

d) The transformers shall be capable of continuous operation in accordance with relevant IS for loading of oil immersed transformers.

e) The neutral terminal of star windings shall be designed for the highest over current that can flow through this terminal.

f) The temperature rise of oil & windings over the specified ambient temperature shall not exceed the limits given below with air as cooling medium when tested in accordance with IS 2026 (Part-2).

Top oil (measured by thermometer)	:	40 ^{0}C
Winding (measured by resistance)	:	45 ^{0}C

g) Noise level of transformers shall be less than 80 dB at a distance of 1 metre.

G. Tap Changer

The standard tapping range shall be +5% to -10% of HV in terms of 2.5 % with taps on HV Side.

H. Off Circuit Tapping Mechanism for Transformer

Tap changing shall be carried out by means of an off circuit externally operated self positioningswitch when the transformer is in de-energized condition. Off circuit tap-changing arrangement shall be either by means of links or by means of an externally-operated switch with mechanical locking device and a position indicator. Arrangement for padlocking shall be provided.

I. Fittings and Accessories

The following fittings and accessories shall be provided for transformer:

(a) Inspection manhole(s) with cover(s) on the top cover of the transformer.

(b) Lifting lugs or eyes for lifting of fully assembled transformer by crane.

(c) Jacking pads, at least four in number, at suitable height, for lifting the complete transformer filled with oil.

(d) Lifting arrangements for

- Complete transformer filled with oil
- For the assembly of core and coils and
- For lifting the tank of large transformers whenever specified.

(e) Hauling eyes on each face of the transformer (for transformer rated 1000 KVA and above).

(f) Skids at the base of the transformer.

(g) A ladder assembly shall be provided to reach the top of the transformer for maintenance work. It shall be possible to padlock the ladder to the transformer tank so that ladder cannot be removed. Usage of transformer structure / marshalling boxes etc as means to climb transformer are not acceptable.

(h) Earthing pads: Two earthing pads of copper or other non-corrodible material shall be welded at the bottom corners of the transformer tank and supplied with clamp type terminals suitable for the Employer’s earthing conductors. Suitable

earthing terminals on cable boxes and separately mounted radiator banks shall also be provided.

(i) Neutral earthing bar of copper of specified section installed from the neutral bushing to ground level suitably supported along its run on porcelain insulators, together with clamping arrangements at neutral bushing and for two Employer's earth conductors. The supporting insulators shall be tank mounted.

(j) Terminal marking and rating plates shall be as per the specified standard and shall also give the following additional information:

- Connection diagram showing the internal connections.
- Guaranteed Temperature rise of winding and oil.
- Insulation levels of the windings, including neutral end of windings with uniform insulation.
- Transportation weight.
- Un-tanking weight.
- Core and winding weight.
- Table giving the tapping voltage, tapping current and tapping power factor for each tap. Values of short circuit impedance on the extreme tappings and on the principal tapping and indication of the winding to which the impedance is relates.

(k) The transformer shall also be provided with the following non-corrodible plates, indelibly marked showing:

- Location and function of all valves and plugs and indication of the maintenance instrument reference for applying vacuum of drying and oil filling.
- Valves connection diagram

(l) The conservator shall be provided with the following accessories:

- Filling plug, sump and drain valve of 15 mm size for conservator of size 650 mm and 25 mm size for conservator above 650 mm diameter.
- 150 mm diameter magnetic type oil level gauge with low oil level alarm contacts and a prismatic oil sight gauge, both

as specified in Data Sheet and provided with markings for minimum oil level and oil level at rated temperature rise.

- A bolted cover at one end for cleaning.

- Valve for shutting off oil to the transformers.

- Weather proof dehydrating breather with silica gel and oil seal to eliminate constant contact with the atmosphere, mounted at a level of about 1400 mm above ground level.

(m) Gas and Oil Actuated Relay (Buchholz Relay)

(n) Temperature Indicators

(o) Dial Type Thermometer

(p) Winding Temperature Indicator

J. Cable Terminations / Cabling Requirement

11kV air insulated cable box with air insulated disconnecting chamber shall be provided with supporting brackets and structure to facilitate their support from ground level. The disconnecting chamber and terminal box shall be air insulated and complete with seal-off bushings, removable flexible connectors/links and removable covers. LT terminal box shall be suitable for connecting LT air insulated bus duct.

All transformers shall be provided with lockable emergency Push Button station near the transformer to trip the transformer as per IER. All transformers shall be provided with alarm annunciation on breaker control panel.

K. Tolerance on Losses

The permissible tolerances on the guaranteed values of transformer losses shall be as per IS 2026/IS 1180. Cost loading shall be done for capitalization of losses at time of bid evaluation for all transformers as per CBIP Manual on transformers.

L. Rejection

- The Employer or Employer’s Representative reserves the right to reject the transformer if the same does not meet the specification requirement, subject to tolerances as per IS 2026.

- The impedance values difference and temperature rise values shall not exceed from the guaranteed specified values.

- The rejected transformers shall be replaced by transformers complying with the requirements of this specification at the Contractor’s cost. If the commissioning of the project is likely to be delayed by the rejection of a transformer, the Employer’s Representative reserves the right to accept the rejected transformer until the replacement transformer is made available.

- Transporting the rejected and replacement transformers as well as installation and commissioning of both the transformers shall be at the Contractor's cost.

M. Drawings and Data

All Drawings, data, technical particulars, temperature rise calculations, detailed literature, catalogues, type test certificates of typical transformer etc. shall be submitted along with the bid/ after award of contract.

N. Tests

Transformers shall be subjected to routine tests & witness test as spelt out in Indian Standards and typical type test certificates shall be made available to Employer/Employer’s Representative . Inspection by Employer/Employer’s Representative will not be carried out unless the Vendor confirms that calibrated equipment is ready for proceeding with the tests.

1.4.6 Specific Requirements for Outdoor LT Kiosk

(a) LT Kiosk shall be outdoor type with 4P, ACB/MCCB located in the transformer yard.

(b) Sheet steel used for fabrication of panel shall be cold rolled.

(c) Panel shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled

sheet steel of thickness not less than 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.

(d) All doors, removable covers, gland plates etc. shall be of at least 1.6 mm thickness and shall be gasketedall round the perimeter.

(e) All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

(f) Degree of protection of the enclosure shall not be less than IP 55.

(g) Operating devices shall be incorporated only in the front of switchgear.

(h) GI Earth bus of size 50mm x 10 mm shall be provided at the bottom.

(i) All doors shall be with concealed type hinges and captive screws.

(j) Each vertical section shall be equipped with 240 V, 1 Phase, and 50 Hz space heater controlled by thermostat.

(k) A 240 V, 1 phase, AC plug point shall be provided in the interior of each cubicle with on-off switch for correction of head lamps.

(l) Panel shall be suitable for bottom entry of cables.

(m) LED type R, Y, B indications shall be provided.

(n) Tests

Switchgear shall be subjected to routine tests & witness test as spelt out in Indian Standards and typical type test certificates shall be made available to Employer/Employer's Representative. All meters and other reference devices used for testing shall have valid calibration from reputed national laboratories/institutes. Inspection by Employer/Employer's Representative will not be carried out unless the Vendor confirms that calibrated equipment is ready for proceeding with the tests.

1.4.7 Specific Requirements of Cabling System

a) Features of Construction:

HV Power Cables

HV cables shall be 3 core, 6.35/11kV (E), XLPE type with stranded aluminum conductors & GI armouring. Minimum size of cable shall be selected based on the short circuit considerations.

LT Power Cables

LV power cables shall be 1.1 kV, XLPE insulated, PVC Sheathed GI steel wire/strip armoured with

Al conductor - for sizes greater than 6 sq.mm

Cu conductor - for sizes upto 6 sq.mm

No. of cores shall be as per requirement.

Control Cables:

All Control cables shall be 650/1100V, stranded copper conductors and GI armouring. No. of cores shall be as per requirement. Minimum size of core shall be 1.5 Sq.mm.

b) Cable Rating:

The Contractor shall ensure that cable and wires associated with the distribution and control systems, plant wiring and all other installations throughout the works are adequately rated for their use.

In assessing the rating of any cable or wire, the following factors shall be taken into account:

i) Maximum voltage drop permissible

ii) Supply voltage and frequency

iii) Type and magnitude of load

iv) Fault level and duration related to circuit protection relays and fuses

v) Circuit over current protection

vi) Route length and disposition of cables

vii) Ambient temperature

viii) Method of installation

All power cables shall be sized for continuous current carrying capacity at the ambient temperature of 45 ^{0}C. The design current of any circuit shall not exceed the full load current of the supplied device by at least 10%.

For all LT Cables, the voltage drop in the cables between the transformer and the switchgear (PCC) or between PCC and MCC for

full load current shall be limited to 2%. Further the voltage drop in cables between PCC/MCC to Motor terminals for full load current shall be limited to 3%. The total voltage drop transformer secondary to motor terminal shall be limited to 5%. Under motor starting conditions the corresponding voltage drop shall not affect the operation of the motor controls or the ability of the motor to start and run effectively and in any event shall not exceed 15%.

c) Cable Colours

All cable cores shall be colour coded throughout their length and shall be so connected between switchboard, distribution board, plant and accessories, that the correct sequence or phase colours are preserved throughout the system.

The colour coding should be as follows:

3 Phase	Red, Yellow and Blue
Single phase or dc	Red and Black
Earth	Green/Yellow
Control	Blue (dc), Red (ac)

d) Cable Conductors

(i) Cores of cross-sectional area greater than 1.5 mm^2 shall be stranded.

(ii) The minimum cross-section of cables shall be

Power Cables : 2.5 mm^2

Control Cables (External use) : 1.5 mm^2

: 1.0 mm^2 (Internal use)

Lighting Distribution Ckts : 1.5 mm^2

Internal wiring of Control Panels : 1.0 mm^2

e) Cable Numbering

All cables shall be allocated a unique number which shall be fixed to each end of the cable using a corrosion resistant label. Cables of different categories shall be tagged with the following subscripts and three digit number.

HV power	HV-P_ _ _
LV power	P_ _ _
Control	C_ _ _
Instrumentation	I_ _ _
Protection	PR_ _ _
Telecommunication	T_ _ _

f) Cable Drums

Cables shall be supplied in non-returnable wooden drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage.

The Bidder shall indicate in the offer, the maximum length for each size of cable, which can be supplied on one drum. The actual length supplied on each drum shall be within tolerance limit of ± 5% without any tolerance on total ordered quantity of each size of cable. However, before winding the cables on drums Contractor shall obtain EMPLOYER’s approval for the drum lengths.

Each drum or coil of cable shall be accompanied by a certificate stating the manufacturer's name, cable size and number of cores, length, result and date of tests as required in the EMPLOYER’s Requirements. Cables manufactured more than 12 months before delivery will not be accepted.

All cables shall be delivered with cable ends effectively sealed by hygroscopic scaling caps. When a cable is cut from a drum both ends shall be immediately sealed to prevent ingress of moisture. Cables shall not be transported to site in loose coils but a number of short lengths of cable may be transported on the same drum. The Contractor shall be wholly responsible for the purchase and/or hire costs of all cable drums and for the removal of these drums from site after use.

g) Cable Installation

Cables shall be installed in such a way that the minimum bending radii is available during installation. Cables shall not be installed in ambient temperatures below that recommended by the cable manufacturer.

Cables grouped together shall have insulation capable of withstanding the highest voltage present in the group.

Cable fire sealing shall be provided such that fire proof cable penetration seals rated for two hours shall be provided as per BS : 476 (Part – 20) or equivalent standards.

Cables of different categories shall be installed so as to maintain satisfactory clearances for safety and in order to reduce the possibility of electrical interference. The following Table details the distances in mm that shall be maintained between the different categories of cable.

Separation Distances in mm between different Categories of Cable

Cable Category	**HV Power**	**LV Power**	**C&I/ Protection**	**Telecommunication**
HV Power	N/A	300	500	500
LV Power	300	N/A	300	300
C&I/Protection	500	300	N/A	100
Telecommunication	500	300	100	N/A

These separations are minimum and special circumstances such as the presence of high current flows, or harmonic content may necessitate larger separation distances.

In order to make economic use of the cable support system, cables shall be arranged in groups of 50 mm maximum overall diameter. These groups shall be securely tied to the cable support system at intervals not exceeding 900 mm for horizontal runs and 300 mm intervals on vertical runs.

Cables shall be laid in a manner such that any electrical interference between cables shall not have a detrimental effect on the life and operation of Station.

Inside the building all cables shall be installed on cable trays & outside the building, all cables shall be directly buried in ground. Minimum depth of laying for directly buried cables shall be as per IS 1255.

h) Cables Laid Direct in Ground

Buried cable up to 650/1100 V shall have a minimum cover of 750 mm measured to the top of the highest cable. On crossing roadways the cable shall be run through a Hume pipe duct of minimum diameter 100 mm with a minimum of 1000 mm cover and encased on all sides by 150 mm of concrete.

Interlocking cable protective covers, minimum 1 m long x 300 mm wide, marked `Danger -Electric Cable' in English and the vernacular shall be laid on top of the sieved sand. Covers shall extend the whole length of the cable trench and shall overlap cables by a minimum of 50 mm.

Warning tape shall be laid a minimum of 200 mm above the protective covers. Cables are to be installed without tees or through joints unless otherwise approved by the EMPLOYER'S REPRESENTATIVE. Single core cables shall be run in trefoil formation.

i) Cables installed in Conduit

The conduit installation should generally conform to the latest versions of IS-732/National Electric Code (NEC)/ NFPA: 70 and in line with CEA guidelines wherever applicable.

(a) **General:**

(i) Conduits shall be galvanized heavy gauge solid drawn or welded screwed steel type and be in accordance with IS 9537 Part 2 or BS 4568. Accessories shall either be malleable cast iron screwed type or pressed steel and galvanized.

(ii) A space factor of 40% shall not be exceeded, but in any case conduit of less than 20 mm diameter shall not be permitted. The tubing shall be perfectly smooth inside and out and free from flaws and imperfections of any kind. Both ends of every length of tubing

shall be properly reamed with all sharp edges removed before erection.

(iii) Where a number of conduits converge, malleable cast iron or heavy gauge sheet steel adaptable boxes shall be employed in order to avoid crossings. Conduits shall be connected by means of male brass bushes and couplings.

(iv) Where conduits are greater than 25 mm, straight through joint boxes shall be of the trough type. Where conduit and/or fittings are attached to equipment casings, the material or case of the casing shall be tapped for a depth of not less than 10 mm or male bushes and flanged couplings shall be used.

(v) Heavy hexagonal lock nuts shall be used at all positions where running joints are required and great care shall be taken to ensure that they seat firmly and evenly on to the mating faces of coupling or other adjacent accessories. All junction boxes, draw-in boxes, and inspection fittings, shall be so placed that the cables can be inspected and, if necessary, withdrawn and re-wired throughout the life of the installation.

(vi) Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits after erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators, etc. Intermediate joints in the cable will only be allowed by arrangement with the EMPLOYER'S REPRESENTATIVE. Where terminal blocks are necessary, they shall be of the porcelain type with brass pinching screws.

(vii) Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt, cement, etc. and covers, either temporary or permanent, shall be fitted on all boxes.

(viii) Generally, conduits shall not cross expansion joints of buildings, but where they cannot be installed in any other manner then a flexible conduit shall be used across the expansion joint. A total 150 mm movement shall be allowed.

(b) **Surface Installation**

(i) Surface conduits shall be secured and fixed by means of distance spacing saddles or approved purpose made clips which allow the conduits to be taken directly into accessories without sets or bends. Conduits shall be run in a square and symmetrical manner. An efficient means shall be adopted to provide for the drainage of condensation and the runs shall be properly ventilated.

(ii) All surface conduit runs shall be marked out for approval by the EMPLOYER'S REPRESENTATIVE before the installation is carried out. Where large multiple parallel conduit runs would occur, use may be made of galvanized cable trunking.

(iii) Conduits installed on structural steelwork shall be secured at spacing not exceeding those for surface conduit by girder clips, otherwise fixing shall be as for surface conduits on walls, drilled and tapped to the metalwork. Power driven fixings shall only be used with the express permission of the EMPLOYER'S REPRESENTATIVE. Any drilling or access which is required through any structural member of the building shall be agreed with the EMPLOYER'S REPRESENTATIVE before carrying out the work.

(iv) Exposed threads and places where galvanizing has been damaged shall be cleaned and then painted with two coats of an approved metallic zinc based paint. This treatment shall be applied as the work proceeds.

j) Cable Terminations and Joints

Power Cable Terminations

(i) Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors. Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.

(ii) Each cable entry into a terminating box shall be made through a suitable gland, which shall have provision for securing the armour where applicable. Where single core glands are required these shall be of the non-magnetic type and the associated box bottom plate, where the core passes through, shall not have a continuous magnetic path.

(iii) Adequate provision shall be made to bond the cable armouring to the box and/or switchgear casing of a suitable size to withstand the prospective short circuit fault current of the system, glands shall be fitted with earth bonding tags where intimate screwed contact between gland and cable box is not possible.

(iv) Where cable glands are exposed to the weather these shall be protected by heat shrink plastic sleeve or purpose moulded sleeves covering the gland continuously from overall sheath to the gland neck.

(v) Where terminations of multicore type have to be made on to items of Plant which have to be dismantled for maintenance, these shall be made off through glands into an adaptable box containing terminals and flexible single cores taken into the equipment via flexible waterproof plastic covered conduit, and a separate earth core linking the box to the equipment.

(vi) Where single core cables are glanded to or pass through cabling plates the gland plate or cabling plate shall be constructed of non-magnetic material.

k) Multi core or Control Cable Terminations

(i) A sufficient number of terminals shall be provided to terminate all cable cores including 10% spare cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.

(ii) Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose-made solid links shall be incorporated in the design of the terminal blocks.

(iii) Terminals which remain energized when the main equipment is isolated shall be suitably screened and labelled.

(iv) Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labelled.

l) Cable Fixings

(i) Ties and strapping shall be suitable for securing cable and cable groups to cable tray or ladder. They shall be resistant to chemical and marine corrosion. Plastic coated metal ties used in order to obtain corrosion resistance shall not be acceptable. Nylon ties shall be resistant to the effects of ultra-violet light and shall be self-extinguishing.

(ii) Large single cables shall be secured with cable clamps or cable cleats.

(iii) Cable Identification: At each end of each cable, in a uniform and visible position, a label shall be fixed on the cable in accordance with the cable schedule. Labels shall be made of PVC and shall be indelibly marked to the approval of the EMPLOYER'S REPRESENTATIVE. The label shall be retained using proprietary nylon strips passing through two fixing holes at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

m) Cable Glands

(i) Glands shall generally be of the mechanical double compression hexagon type. Earth continuity of brass glands shall confirm to BS: 6121/ EN 50262: 1999. This may be achieved by the rigid clamping of the armour within the gland and the intimate contact between the threaded components of the gland and the equipment. Each gland shall be installed complete with proprietary earth tag providing a ready means of connecting a flexible strand or strip earth bond to the gland at any position around the gland in relation to the associated apparatus. Adequate earth continuity shall be assured between the earth tag, the gland and the armour wires of the cable where applicable.

(ii) Glands for single core cables shall be constructed from non-magnetic materials. Each gland shall be installed complete with a proprietary non-ferrous lock-nut to secure the gland body to the equipment where the entry hole is plain, i.e. not tapped.

(iii) Where holes for cable entries are not provided it shall be the responsibility of the Contractor to mark out and drill such holes. Burrs and swarf shall be removed, care being taken to ensure that swarf and filings, etc do not enter the equipment.

(iv) Cable glands in situations where moisture may be present shall be double seal weatherproof type, gland shrouds shall be used and entry shall be sealed.

(v) For dry indoor situations, standard industrial glands with shrouds are acceptable.

n) Tests

(a) Certified copies of reports of type tests carried out on similar type and rating of cables (offered under this contract) within last five years from the date of submission of Bid has been furnished to the Employer for review and approval. Type tests will also include anti rodent and anti termite test. In case the type test reports are not found to be meeting the contract document requirements, the Vendor will conduct all such tests under this contract free of cost to the EMPLOYER and submit the reports for approval.

(b) Copies of test certificates for all tests conducted on cables ordered shall be furnished to the EMPLOYER / EMPLOYER'S REPRESENTATIVE for approval. No cable shall be dispatched without obtaining approval of test certificates.

1.4.8 Specific Requirements of Lighting Luminaries

a) General

Luminaries shall be designed for continuous trouble-free operation without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather-proof and rain-proof type (IP-65).

The Luminaries shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps/starters etc.

Connections between different components shall be made in such a way that they will not work loose by small vibration.

For each type of Luminaries the Contractor shall furnish the utilisation factor tables to indicate the proportion of the light emitted by the bare lamps which falls on the working plane.

All Luminaries shall be supplied complete with lamps suitable for operation on a supply voltage with the variation in supply voltage, frequency and combined voltage and frequency of ±10%, ±5% and +10% respectively.

The Luminaries and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant Standards.

Outdoor type fixtures shall be provided with outdoor type weather-proof box.

Each luminaire shall have a terminal block suitable for loop-in, loop-out and T-off connection by 250/400 V, 1 core, PVC insulated copper/aluminium conductor wires upto 4 sq.mm in size. In outdoor areas the termination at the luminaire shall be suitable for 1100 V, PVC insulated, copper/aluminium conductor, armoured cables of sizes upto 6 sq.mm/10 sq.mm conductors. Terminals shall be of stud or clamp type. The internal wiring should be completed by means of standard copper wire of minimum 1 sq.mm size and terminated on the terminal block. Terminal blocks shall be mounted with minimum two fixing screws.

The fixtures provided shall be energy efficient and shall be consuming less power.

Earthing:

- Each luminaire shall be provided with an earthing terminal suitable for connection to the earthing conductor of 12 SWG GI wire.

- Where separate control gear box is provided for housing the accessories the same shall be provided with an earthing terminal suitable for connecting earthing conductor of 12 SWG GI wire.

- All metal or metal enclosed parts of the luminaire/control gear box shall be bonded and connected to the earthing terminal so as to ensure satisfactory earthing continuity.

Painting/Finish:

- All surfaces of the Luminaire/Control gear box housing accessories shall be thoroughly cleaned and degreased. It shall be free from scale, rust, sharp edges and burrs.

- When enamel finish is specified, it shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surface. The finish shall be non-porous and free from blemishes, blisters and fading.

- The luminaire housing shall be stove-enamelled/epoxy stove-enamelled-vitreous enamelled or anodized as indicated under various types of fittings.

- The surface shall be scratch resistant and shall show no sign of cracking or flaking when bent through 90 deg. over 1/2” dia. mandrel.

- The finish of the luminaire shall be such that no bright spots are produced either by direct light source or by reflection.

- External control gear box provided for housing accessories shall be painted or galvanized.

b) LED Lighting – General Requirements

- High Power White LEDs used in the luminaries shall have wattage greater than ONE watt.
- LED shall be operated at a forward current of less than 90% of the rated current.
- Colour Rendering Index (CRI) of the LEDs used in the luminaire shall be greater than 70.
- The illumination of the luminaire shall be uniform without dark bands or abrupt variations and soothing to the eye.
- Light Uniformity Ratio (Emin / Eavg) would be > 0.4.
- Luminary Body Temperature would be less than 30 0C above the ambient, even after continuous burning of Luminary for 24 Hrs.
- The Luminaire works on single phase three wire system (Phase, Neutral & Earth).
- The luminaire housing is made up of Corrosion free High Pressure Aluminum die cast thus confirming the luminaire to IP-68 protection and safety as per IEC 60598-1.
- The Luminaire is equipped with distortion free, clear, Heat Resistant toughened, UV stabilized glass cover in the front fixed to the die cast Aluminum frame which would be fixed to the housing by means of stainless steel screws.
- The **minimum technical specifications for LED lighting** will be as follows:

a) Powered by the latest bright LEDs with high efficiency and meeting LM-80 standard.

b) Average rated life span of 50000 hrs.

c) LED efficacy shall be greater than 125 Lumens/watt.

d) Luminaire efficacy of at least 80 Lumens/watt.

e) Input voltage range 90-300 V.

f) Power factor > 0.9.

g) THD < 15%.

h) Ingress protection as per IP 68 for outdoor luminaries

i) Operating temperature -5°C to 50°C

j) Storage temperature -5^0 to 70^0C

k) Humidity 10% - 100%

l) LEDs shall be operated at a forward current less than 90% of its rated current.

m) The LEDs used in the luminaire shall have minimum angle of 120 degree.

n) Colour rendering index (CRI) of the LEDs shall be greater than 70.

o) Conform to Photo Biological Safety for the LEDs as per IEC 62471.

p) Free replacement warranties of 5 years for technical defects.

c) Lighting Poles

(a) Lighting poles for street lights and flood lights shall be of octagonal type steel poles. Octagonal poles shall conform to latest standards and it shall be designed to withstand the maximum wind speed as per the latest standards. Poles shall be hot dip galvanized internally and externally after fabrication as per the latest standards. The steel sheet used to manufacture steel poles shall be of minimum thickness of 3 mm and shall conform to the latest standards. Junction boxes shall be camouflaged and shall be provided with weather proof flush doors and locking facility. Bidder shall design and furnish the foundation drawings for the poles to withstand basic wind speed of minimum 50 meter/sec.

(b) The supply of poles shall be complete with fixing bracket/necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes.

d) Lighting System Equipment

A. Lighting Panels

Constructional Features

(a) Boards/Panels shall be sheet steel enclosed and shall be fully dust and vermin proof, providing a degree of protection of min. IP 43. The sheet steel used for frame, frame enclosures, doors, covers and partitions shall be cold rolled 2 mm thick.

(b) All boards/ panels shall be provided with hinged doors for access to equipment. Doors shall be gasketed all round with neoprene gaskets. For wall mounting, 3-phase ways lighting panels when provided with MCBs, a hinged, latched front door shall be provided with key-locking facility and a slotted Bakelite sheet shall be provided inside. Only the MCBs operating knobs or the fuse cap covers shall project out of the Bakelite sheet slots for safe operation and neat appearance. Incomer to lighting panels shall be provided with TPN MCB with ELCB.

(c) All accessible live connections/metals shall be shrouded and it shall be possible to change individual fuses, switches, MCBs from the front of the boards/panels without danger of contact with live metal.

(d) For wall/column/structure mounting type panels suitable mounting straps shall be provided.

(e) Adequate interior cabling space and suitable removable cable entry plates shall be provided for top/bottom entry of cables through glands and or conduits as required. Necessary number of glands to suit the specified cable sizes shall be provided. Cable glands shall be screwed on type and made of brass.

(f) Two earthing terminals shall be provided to suit the earthing conductor.

(g) All sheet steel parts shall undergo rust-proofing process which should include degreasing, de-scaling and a recognized phosphate process. The steel works shall then be painted with two coats of Zinc - chromate primer and two coats of final stove-enamelled finish paint of specified colour.

B. Panels/Board Component Equipment

(a) Miniature Circuit Breakers (MCB) / ELCB / RCCB

(i) MCBs shall be hand operated, air break, quick make, quick break type conforming to applicable standards.

(ii) The switch shall be protected by fuse and the MCB shall be provided with overload/short-circuit protective device for protection under overload and short-circuit conditions. The minimum breaking capacity of MCBs shall be 9 kA r.m.s. at 415 V/220 V D.C.

(iii) Switch shall have provision for locking in both fully open and closed positions. MCBs shall be provided with locking facility.

(iv) The incomer shall be MCCB, phase segregated and shall be insulated. All live connections shall be shrouded. RCCB with suitable rating shall be provided for incomer and 30 mA power receptacle.

C. Light Control box and switches

(a) Light control switches of ratings and types, i.e. decorative/industrial shall be supplied as required. The switches shall be Modular suitable for use on 240 V, 1 Ph, and 50 Hz supply.

(b) Switches shall be of flush type for mounting behind an insulated modular plate or incorporated with a switch plate for mounting flush with the surface of wall or switch box/suitable enclosure. The modular switch box / enclosure may be recessed into or mounted on a wall as per the requirement of project layouts.

(c) The size of enclosure modular boxes shall be chosen to accommodate the number of switches to be installed at the particular location. The enclosures shall be 18 gauge sheet steel galvanized. The enclosure plates / boxes shall be fabricated out of quality tested raw material such as metal, PVC, power coated metal. An enclosure intended for surface mounting shall not have holes or gaps in its sides other than those expressly provided for cable entry.

D. Receptacle Units

(i) Receptacle units shall consist of socket outlet with associated switch and plug. The socket outlet and switch (5/6A) or MCB (15/16A) shall be flush mounted within galvanized 18 gauge steel / modular enclosure with insulation cover. The box may be recessed into or mounted on a wall as per requirements of project layouts.

(ii) The receptacle units shall be suitable for 240 V, 1 ph - N, 50 Hz, 5/6A, 415 V, 3 Ph – N, 50 Hz, 15/16A supply as required.

(iii) Single phase receptacles 15/16A shall be associated with ELCB and MCB of same current rating and the receptacle shall become live only when the associated ELCB and MCB are in “ON” position.

(iv) Three phase receptacles shall be metal clad associated with a TPN MCB housed in the same enclosure. The receptacle shall become live only when the associated MCB switch is in “ON” position.

(v) The plugs shall be provided along with three phase receptacle with cord grips to prevent strain and damage to conductors/wires at connection and entry points.

E. Lighting Wires

(a) The wires for wiring in lighting system shall be 250/440 V, 1C, PVC insulated, with stranded copper conductors.

(b) The minimum area of conductors shall be 2.5 sq.mm. for light fittings and 5A Receptacles and 4 sq.mm for receptacles rated 15 A and above.

(c) The wires shall be coded white for phase/positive of D.C. and black for neutral/negative of D.C.

F. Conduits

(a) Rigid steel/non-metallic conduits and their associated fittings as required shall conform to applicable standards.

The minimum size of conduit shall be 20 mm for surface installation and 25 mm for concealed installation.

(b) Steel conduits shall be seamed by welding and hot dip galvanised. They shall be supplied in standard lengths of 5 m.

(c) Supply of conduits shall include all associated fittings like couplers, bends and tees as required for lighting system installation work.

G. Junction Boxes

(a) Junction boxes with terminals shall be supplied for branching and terminating lighting cables when required for outdoor areas, 3 phase receptacles etc.

(b) The junction boxes shall be dust and vermin proof and shall be fabricated from 14 gauge sheet steel and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weather proof.

(c) The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable/conduit entry knock outs, terminal blocks, HRC fuses as required.

(d) The terminal blocks, with specified number of terminals, shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 600 V, grade, one piece construction complete with terminals, insulation barriers, galvanised nuts, bolts and washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type.

(e) The boxes shall be painted with one shop coat of Red oxide zinc chromate primer followed by a finishing coat of paint.

1.4.9 Specific Requirements of Earthing& Lightning Protection System

General

- The earthing and lightning protection system covers earthing conductors, earth electrodes and accessories.
- Metallic frame of all electrical equipment shall be earthed by two separate and distinct connections to earthing system. Crane rails, tracks, metal pipes and conduits also shall be earthed at two points.
- Steel RCC Columns, metallic stairs and rails of the building housing electrical equipment also shall be connected to nearby earthing grid conductor. Metallic sheaths/ screens and armour of multicore cables shall be earthed at both ends. Metallic sheaths and armour of single core cables shall be earthed at the switchgear end only.
- Every alternate post of switchyard fence shall be connected to the earth grid by GS flat and gates by flexible lead to earthed post.
- Each Continuous laid length of cable tray shall be earthed at minimum two places by GS/GI Flats to earthingsystem, the distance between the earthing points shall not exceed 30m.
- Lightning Protection System shall compromise vertical / horizontal air terminations, down conductors, test limits and earth electrodes. Air terminations, down conductors and test links shall be of galvanised steel conductors and earth connection below the ground level shall be of mild steel.
- Lightning Protection System down conductors shall not be connected to other earthing conductors above the ground level.
- The earth electrode system shall comprise one or more earth electrodes, earthing network, mesh or a combination of these in order to obtain the required earth electrode resistance.
- For equipment earthing as well as neutral earthing, two earth leads shall be provided from different sources/ routes in order to maintain redundancy.
- All the equipments of same voltage level like 415V etc., shall be earthed at two different points on each equipment with GS flats of size suitable to withstand the system fault current for the respective voltage class. All such earth leads shall be interconnected with GS flat of same size to form an earth grid which is further connected to minimum two (2) independent earth electrodes.
- The material used for the earthing conductor shall be as follows:

(a) Conductors above ground shall be galvanised steel flat;

(b) Conductor buried in the ground or embedded in concrete shall be galvanised steel, rod /flat. Allowance shall be made for reduction in the cross section of the steel over the design life of the earthing system & Corrosion factors;

- Earth electrodes where used shall be of heavy duty GI Pipe of not less than 40 mm NB and 3000 mm long. Where multiple electrodes are used they shall be separated by a distance of not less than the driven length.
- All earth electrodes including connections shall be housed in individual concrete inspection chamber flushed to the finished ground level and shall allow disconnection for testing of individual electrodes. The chamber shall be permanently marked `Electrical Earth'
- All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by the EMPLOYER/EMPLOYER'S REPRESENTATIVE.
- Unless otherwise stated all excavation for the installation of the earth electrodes and the inspection pit shall be carried out by the Contractor.
- After the earth installation has been completed the Contractor shall demonstrate to the EMPLOYER that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes and test instruments required for the tests shall be provided by the Contractor.
- Equipotential bonding conductors shall have the following minimum sizes.

a) Main Equipotential Conductors

- Main Earth Conductor buried in earth GS flat 50 x10mm
- main switchboard 50 x 10 mm flat

b) Equipotential Conductors

- power factor correction capacitor panel 25 x 3 mm flat

- local push buttons 12 SWG wire
- lighting and receptacle system 12 SWG wire
- outdoor street lighting 8 SWG wire
- ladder rack and cable tray at suitable points 25 x 3 mm flat
- hand rails and metallic structures 25 x 3 mm flat
- building reinforcement 25 x 3 mm flat
- incoming and outgoing process services 25 x 3 mm flat
- steel structures comprising storage tanks, 25 x 3 mm flat
- LV Motors
- up to 10 kW 12 SWG wire
- 10 to 20 kW 8 SWG wire
- 20 to 50 kW 25 x 3 mm flat
- Earth electrode 40mm dia. 3000 mm long heavy Duty G.I. pipe electrode

Notes:

1 Equipotential conductors shall interconnect between the device to be bonded and the main equipotential conductor.

2 Connections to building structural steelwork or concrete reinforcement shall be made by a bolted connection to a tag welded to the steelwork or reinforcement bars. Unless otherwise specified at least two connections shall be made to the steelwork and reinforcement bars at the perimeter of each building at diagonally opposite locations.

Lightning Protection System

a) The need of lightning protection has been established by

- Calculating the overall risk factor for each building, structure etc., as per procedure given in IS/IEC 62305-2.

- Analysing the zone of protection provided by air termination conductors on tall structures in the plant area.

b) Air termination system comprising of rods/mesh or combination of both will be provided and the following methods shall be used to determine the positioning of Air termination system will be as per IS 62305.

- The protection angle method
- The rolling sphere method
- Mesh method

c) Air termination system will be connected to the earthing system by down conductors fixed along the outer surface of building. Number & layout of the down conductors will be as per IS/IEC 62305.

d) Each down comer will be terminated to a separate treated test earth electrode which in turn will be connected to station earthing system.

e) Test link will be provided in the run of each down conductor at approximately 1000 mm above ground level.

f) Air termination system shall be connected to earthing system below ground by down conductors. For this purpose separate treated earth pit to be constructed. The down conductors shall follow a direct path to earth. There shall not be any sharp bends, turns and kinks in the down conductors.

g) All joints in the down conductors shall be of welded/brazed type. All metallic structures within 2 meters from down conductors shall be bonded to lightning protection system.

h) The lightning protection system shall not be in direct contact with underground metallic service ducts, cables, cable conduits and metal enclosures of electrical equipment. However all metal projections, railings, vents, tanks etc. above the roof shall be bonded together to form a part of roof grid.

i) The lightning protection air termination rods and/or horizontal air termination conductors shall be fixed in such a way that they remain in their installed position even during severe weather conditions. The necessary accessories such as cleats, clamps, welding materials, bolts, nuts, shall be supplied by CONTRACTOR.

j) Galvanising:

Wherever galvanising has been specified, the hot dip process shall be used. The galvanised coating shall be of uniform thickness. Weight of Zinc coatings for various applications shall not be less than those indicated below:

a) Fabricated Steel	
Thickness less than 2 mm, But not less than 1.2 mm	340 gms/sq.m
Thickness less than 5 mm, but not less than 2 mm	460 gms/sq.m
Thickness 5 mm and over	610 gms/sq.m
b) Fasteners	
upto nominal size M10	270 gms/sq.m
over M10	300s/sq.m

Burrs shall be removed before galvanising. Any site modification of galvanised parts should be covered well by zinc rich primer and aluminium paint.

1.4.10 Technical Data Sheets

A. Technical Data Sheet – 11kV Load Break Switch

Sr. No	Description	Unit	Technical Particulars
1.1.	Rated Voltage	kV	12
1.2.	Installation		Outdoor
1.3.	Rated Current	Amps	630
1.4.	Permissible Services Voltage	kV	10-12
1.5.	Rated Short time current	kA	26.3
1.6.	Rated Making	kA	65

Sr. No	Description	Unit	Technical Particulars
		(Peak)	
1.7.	Rated Insulation Level		25kV/75kV Peak
1.8.	Rated Frequency	Hz	50
1.9.	No. of Poles		3
1.10.	No. of Breaks / Pole		Single
1.11.	Applicable Standard		IS 9920

B. Technical Data Sheet – 11kV VCB

Sr. No	Description	Unit	Technical Particulars
2.1.	Nominal System Voltage	kV	11
2.2.	Highest System Voltage	kV	12
2.3.	Rated Voltage	kV	12
2.4.	System frequency	Hz	50
2.5.	Number of Phases		3 Phase/3 Wire
2.6.	Lightning Impulse Withstand Voltage Phase-to-Phase & Phase-to-Earth:	kV(peak)	75
2.7.	Power Frequency Withstand Voltage to Earth, Between Poles, & Across Opening Span	kV rms	28 kV rms for 1 minute
2.8.	Rated Short Time Withstand/Breaking Current:	kA (rms)	20
2.9.	Rated Duration of Short Circuit:		3 seconds
2.10.	Rated Normal Current:	A	630 Amps (rms)

C. Technical Data Sheet – LV Switchgear

Sr. No	Description	Unit	Technical Particulars
3.1.	**Switchgear & Bus bar rating**		
3.2.	Rated voltage, phases & frequency		As per SLD
3.3.	System neutral earthing: (effectively/non effectively)		Solidly Earthed
3.4.	Maximum System Voltage		433 V
3.5.	One minute power frequency voltage		
	A) Power circuits B) Control circuits C) Aux. Circuits connected to Sec. Of CTs	VOLTS VOLTS VOLTS	2500 1500 2000
3.6.	Continuous current rating of bus bars under site reference ambient temperature		As per SLD
3.7.	Reference ambient temperature	˚C	45
3.8.	Maximum temperature of bus bars, droppers and contacts at continuous current rating under site reference ambient temperature	˚C	85
3.9.	Short circuit withstand for bus bars and droppers A) Short time (1 sec.) at 415v B) Dynamic rating	kA(RMS) kA(Peak)	As per SLD
3.10.	Standard applicable		As per specifications
3.11.	**Switchgear Particulars:**		As per SLD
3.12.	**Switchgear constructional requirements**		
a	Thickness of sheet steel	MM	As Per

Sr. No	Description	Unit	Technical Particulars
	Cold rolled Hot rolled	MM	Specifications
b	Degree of protection as per IS:13947		IP 54 indoor and IP55 for outdoor
c	Colour finish shade as per IS:5 Interior Exterior		Interior: Glossy White Exterior: Light Semi Glossy shade : 631 as per IS:5
d	Earthing bus Material Size	MM	GI
e	Earthing conductor	MATL. SIZE	50x10mm
f	Clearances in air of live parts		Phase to Phase : 25.4 mm Phase to earth : 19.4 mm
g	Metal enclosed bus duct/ bus trunking entry to cubicles if required		a) Top b) Indoor
3.13.	**Starters**		As per SLD
a	Type		DOL/Rev/Y-Δ/ any other
b	Contactor rated duty as per IS:13947	YES/ NO	To be furnished by Bidder
c	Utilisation category as per IS:13947	YES/ NO	To be furnished by Bidder
d	Control scheme & bill of material enclosed	YES/ NO	To be furnished by Bidder
e	Control transformer : A) Separate for each module	YES/ N	To be furnished by Bidder

Sr. No	Description	Unit	Technical Particulars
	B) Common for each switchgear section with 100% standby	YES/ NO	
f	Single phasing preventor required	YES/ NO	To be furnished by Bidder
g	Standard applicable		As Per Specifications
h	Thermal over load relay reset	Hand/ Auto	To be furnished by Bidder
3.14.	**Breakers**		
a.	Circuit breaker type		Air Circuit Breaker
b.	Voltage, frequency & no. Of phases		415V, 50HZ, 3
c.	Rated breaking duty		O-0.3 SEC-CO-3 SEC-CO
d.	Rated breaking capacity A) MVA B) KA(RMS) at 415V 0-25 PF		As per SLD
e.	Short circuit with stand current for 1 sec. Duration	kA	
f.	Rated making current	kA(Peak)	
g.	Rated current at site reference ambient temperature	A	
h.	Type of operating mechanism		
i.	Key interlocking required	YES/ NO	
j.	Shunt trip required	YES/ NO	

Sr. No	Description	Unit	Technical Particulars
k.	Protection required : A) relays/series releases B) relay type & settings C) under voltage release Required	YES/ NO Setting	
l.	Minimum no. Of auxiliary contacts		
m.	Control voltage A) for spring charging motor B) for closing/tripping	V,AC/ DC	230V AC
n.	Emergency manual operation required in addition to electrical operating devices: A) for spring charging & closing B) for tripping	YES/ NO YES./ NO	
o.	Annunciator required	YES/ NO	
p.	Standards applicable		As per specifications
3.15.	**MCCBs**		
a.	Moulded case circuit breakers to be provided A) for motor control circuits B) for other circuits	YES/ NO YES/ N	As per SLD

Sr. No	Description	Unit	Technical Particulars
		O	
b.	Voltage, frequency & no. Of phases		415V, 50HZ, 3
c.	Rated operating duty		
d.	Rated breaking capacity (at 415V 0.25 p.f.)	kA (RMS)	As per SLD
e.	Rated making current	kA (Peak)	
f.	Rated current at site reference ambient temperature		
g.	On/Off operation : Manual Remote power operated	YES/ NO YES/ NO	YES NO
h.	Releases required : Overload inverse time Under voltage	YES/ NO YES/ NO	YES NO
i.	Standard applicable		As per Technical specifications
3.16.	**Essential spares**		
	Description		Essential Spares To Be Furnished
	A) Complete breaker with Operating mechanism and Releases where specified i) ii)		

Sr. No	Description	Unit	Technical Particulars
	iii)		
	B) Closing & tripping coils		
	C) Spring, charging motors, Along with closing & tripping Springs in case of spring Operated breakers		
	D) Auxiliary contact blocks		
	E) Moving auxiliary contact Blocks		
	F) Breaker control switches		
	G) Local/remote selectorSwitches		
	H) protective relays -50 S/C -49 -50N -50 LR -27 -51 -Auxiliary relays -Timers		

D. Technical Data Sheet – LT Cables

Sr. No.	Description	Unit		Technical Particulars
4.1.	**1100 V Grade XLPE Insulated Power Cables**			
(a)	Make			As per Preferred Makes/Manufacturers
(b)	Applicable Standards			As per specification

Sr. No.	Description	Unit		Technical Particulars
				requirement
(c)	Cable size selection			Refer SLD & BOQ
(d)	Conductor material			Upto 6 sq.mm – Copper Above 6 sq.mm - Aluminium
(e)	Insulation			XLPE
(f)	Inner sheath			Extruded PVC, type ST-2
(g)	Armouring			Galvanised steel flat strip/round wire
(h)	Outer sheath			Extruded PVC, type ST-2
(i)	Overall diameter of cable			To be furnished by the Bidder
(j)	Recommended minimum bending radius	mm		To be furnished by the bidder
4.2.	**1100 V Grade PVC Insulated Power Cables**			
(a)	Make			As per Preferred Makes/Manufacturers
(b)	Applicable Standards			As per specification requirement
(c)	Cable size selection			Refer SLD & BOQ
(d)	Overall diameter of the cable	mm		To be furnished by the Bidder
(e)	Recommended minimum bending radius	mm		To be furnished by the bidder
4.3.	**650/1100 V Grade PVC Insulated Control Cables**			
(a)	Make			As per Preferred Makes/Manufacturers
(b)	Applicable Standards			As per specification

Sr. No.	Description	Unit	Technical Particulars
(c)	Rated voltage		As per requirement
(d)	Cable size selection		As per specifications requirement
(e)	Conductor material		Stranded, copper, EC grade
(f)	Insulation		PVC
(g)	Inner sheath		To be furnished by the bidder
(h)	Armouring		To be furnished by the bidder
(i)	Outer sheath		To be furnished by the bidder
4.4.	Inspection and test categories		As per Specifications

E. Technical Data Sheet – LED Lighting System

Sr. No.	Description	Unit	Technical Particulars
5.1.	**System Particular**		LED Lighting
(a) Make			As per Preferred Makes/Manufacturers
(b) Type			As per specification
(c)	Illumination levels at various premises		IS:3646 Part-I & as per specifications
(d)	Normal supply voltage, phase and frequency		230 V, 1 ph, 2 wire, 50 Hz
	Variation in supply:		
	(i) Voltage (AC & DC)	%	± 10
(ii)	Frequency	%	± 5
(iii)	Combined voltage & frequency	%	+10

Sr. No.	Description	Unit	Technical Particulars
	(iv) D.C. system		-
	Rated	V	110
(e)	Reference ambient temperature	^{0} C	45 ^{0}C
(f)	System short-circuit level		
	(i) At 230 V, A.C.	kA (rms)	10
	(ii) At 110 V.D.C.	kA (D.C.)	6
(g)	Luminaire terminal suitable for		
	Indoor area		
	(i) Conductor material		Copper
	(ii) Cable size	Coresx mm^2	2.5 sq.mm
	Outdoor area		
	(i) Conductor material		Copper
	(ii) Cable size	Coresx mm^2	Refer SLD & BOQ
(h)	Luminaire earthing terminal suitable for		
	(i) Conductor material		G. I. wire
	(ii) Conductor size SWG		Refer BOQ
5.2.	**Distribution Board/Panels**		Not Applicable (NA)
(a)	Main, floor mounted distribution boards		NA
(i)	Main Lighting distribution board(A.C.)		NA

Sr. No.	Description	Unit	Technical Particulars
	Make		NA
	Type		NA
	Degree of protection		NA
	Bus bar material		NA
	Bus bar current rating	A	NA
	Short circuit current rating	kA	NA
	Cable entry		NA
	Location		NA
(ii)	Emergency Lighting Panel (A.C.)		NA
	Make		NA
	Type		NA
	Degree of protection		NA
	Bus bar material		NA
	Bus bar current rating	A	NA
	Short circuit current rating	kA	NA
	Cable entry		NA
	Location		NA
(iii)	Single phase/Three Phase DBs, wall/structure mounting		
	SLDB/TLDB for indoor area		TPN DB (As per SLD & BOQ)
	Make		As per Preferred Makes/Manufacturers
	Type		Wall mounting, sheet steel enclosed
	Degree of Protection		IP 43
(iv)	SLDB/TLDB for outdoor area		TPN DB (As per SLD & BOQ)

Sr. No.	Description	Unit	Technical Particulars
	Make		As per Preferred Makes/Manufacturers
	Type		Wall mounting, sheet steel enclosed
	Degree of Protection		IP 55
(v)	Paint Finish		
	Colour shade:		Interior : Glossy white
			Exterior: Light grey semi glossy shade 631 of IS:5
5.3. (a)	**Street Light Poles** Street Light Pole		Octagonal
	Total Height:	m	7m/8m
	Quantity:	Nos.	Refer BOQ
5.4.	Inspection and test categories		As per Specifications

Note:

Any requirement/ features/ provisions not specifically mentioned in the Specification, but are necessary for trouble free and smooth operation of the system shall be included.

1.4.11 List Of Standards

HV Switches

General requirement for Metal Enclosed Switchgear	IEC 62271- 200/ IEC 60 298/ IS 12729: 1988
Medium Voltage Switches	IEC 265
Alternating Current disconnector's (Load Break Isolators) and earthing switch	IEC 60129/ IEC 62271 – 102/ IS 9921

AC metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV	IS 3427
Classification of degrees of protection provided by enclosures of electrical equipment	IS 12063
High Voltage Switches	IS 9920 (Parts 1 to 4)
Specification for AC disconnectors and earthing switches for voltages above 1000 V	IS 9921 (Parts 1 to 5)
HV AC Circuit Breakers	IS 13118
Dimensions of terminals of HV Switchgear and Control gear	IS 10601
General requirements of switchgear and control gear for voltages exceeding 1000 V	IS 12729
High voltage/Low voltage prefabricated substations	IEC 1330
Common clauses for MV switchgear standards	IEC 60694
Monitoring and control	IEC 6081
Current Transformers	IS 2705
Voltage transformers	IS 3156
Specification for Static Protective Relays	IS 8686
Standards for high voltage metal clad switchgear up to 52 KV.	IEC 62271-200

LV Switchgear

a) Switchgear General Requirements	IS:13947/BS:5486/IEC:60947
b) Factory Built Assemblies of SWGR and Control gear for Voltages upto and including 1000V AC & 1200V DC	IS:8623/BS:5486/IEC:60439
c) Moulded Case Circuit Breaker	IS 2516 / IEC 60947-2/ BS EN 60947-2
d) Miniature Circuit Breakers	IS:8828/BSEN:60898

e) Low voltage Fuses	IS:13703/BS:1362/IEC:60269-1
f) Contactors	IS:13947/BS EN60947-4 /IEC:60947-1
g) Starters	IS:13947/BS EN60947-4/ IEC:60292-1TO 4
h) Control Switches / Push buttons	IS:6875/BSEN 60947
i) Current Transformers	IS:2705/BS:7626
j) Voltage Transformers	IS:3156/BS:7625/IEC:60044, 60186
k) Indicating instruments	IS:1248/BS:89/IEC:60051
l) Marking and Identification of Conductors and Apparatus Terminals	IS:11353/BS:159
m) A.C. Electricity Meters	IS:722, 8530/BS:5685 / IEC 60145,60 211
n) Degree of Protection	IS:13947/IEC:60947-P1
o) Selection installation and maintenance of switchgear and controlgear	IS:10118
p) Code of practice for phosphatising iron and steel	IS:6005/BS:3189
q) Specification for copper rods and bars for electrical purposes	IS:613

Transformers

The transformers shall conform to the latest applicable standards specified below

Power Transformer	IS:2026/BS:171/IEC:60076 IS11171
Fittings and Accessories	IS:3639
Outdoor type Oil immersed distribution transformers upto 2500kVA, 33kV Transformer	IS:1180-2014
Loading of oil immersed transformer	IS:6600/BS:CP.1010 /IEC:60354
Transformer Oil	IS:335/BS 148/IEC:60296

Bushings for > 1000V, AC	IS:2099/BS:223/IEC:60137
Bushings for ≤ 1000V, AC	IS:7421
Degree of Protection	IS:13947 (Part 1) / IEC:60947-1
Double float type Buchholz Relay	IS:3637
Electrical insulation classified by thermal stability	IS1271/BS:2757/IEC:60085
Climate Proofing	BS:CP1014
Code of Practice for selection, installation and Maintenance of transformers	IS - 10028
Manual on Transformers	CBIP Publication No.295

7.14.1. Cables

The cables shall conform to the latest applicable standards specified below.

a) PVC insulated cables : IS: 694

(For voltage upto 1100 V)

b) HRPVC & PVC insulated cables : IS: 1554

Heavy duty

c) Cross linked polyethylene insulated : IS: 7098

PVC sheathed cables

d) Low frequency cables and wires with : IEC: 60189-1 &PVC insulation and sheath IEC-60189-2

e) PVC insulation and sheath of electric : IS: 5831

Cables

f) Polyethylene insulation and sheath for : IS: 6474

Electric cables

g) Conductors for insulated electric cables : IS: 8130

h) Methods of test for cables : IS: 10810

i) Specification for drums of electric cables : IS: 10418

j) Specification for PVC insulated cables : BS: 6346

for electricity supply

k) Specification for PVC insulation and : BS: 6746

sheath of electric cables

7.14.2. Lighting

a) Electrical lighting fittings general and : IS: 1913/ BS: 4533

Safety requirements

b) Code of practice for industrial lighting : IS: 6665

c) Calculation of co-efficient of utilization : IS: 3646 (Part - III)

7.14.3. Earthing

a) Code of Practice for Earthing : IS: 3043

b) Code of Practice for the Protection of : IS/IEC: 62305 (Part-1 to 4)Building and allied structure against lightning

c) Hot dip galvanizing : IS: 2629, 2633, 4759

d) Structural steel : IS: 2062& 808

e) Welding : IS: 816

7.14.4. Electrical Installation

National Building Code of India	SP 7 : 2016
National Electrical Code	SP 30 : 2011
National Lighting Code	SP 72 : 2010
Fire Safety of Buildings (General): Electrical Installations — Code of Practice	IS: 1646

1.4.12 Preferred Makes/ Manufacturers

All the equipment shall be of make listed in the enclosed list of approved make of equipment. **The items shall meet specifications. Mere mention of a make as approvedmake in the below list**

does not qualify for acceptance of an item. BIDDER shall submit the offered make from the list along with the BID.

SL. NO	DESCRIPTION	MANUFACTURER/MAKE
1.	Distribution transformers	M/s. Crompton Greaves Limited/ Volt Amp/ Kirloskar Electric/Areva T & D OR Equivalent Make
2.	11 kV Metal enclosed switchgears/MCC	M/s. Siemens/ ABB/ Crompton Greaves Limited/ Schneider/Areva OR Equivalent Make
3.	HV Vacuum Circuit Breake	M/s. Siemens/ ABB/ Crompton Greaves Limited/ Schneider/Areva OR Equivalent Make
4.	Numerical Relays	M/s. ABB/Siemens/ArevaOR Equivalent Make
5.	H.T & L.T Current Transformers	M/s. ABB/ Areva T&D/ CGL/ BHEL OR Equivalent Make.
6.	LV Switchgears /MCC	M/s. Schneider Electric/ ABB/ Siemens/ GE/ L&T OR Equivalent Make.
7.	L.T Power Capacitors	M/s. ABB/ CG Power Systems/ Universal/ Madhav/ Shreem/ L&T OR Equivalent Make.
8.	Lighting Fixtures and Accessories	M/s. Philips/ Crompton Greaves Limited/ Wipro/ Bajaj Electricals OR Equivalent Make.
9.	MLDB’s, LDB’s, SDB’s, MCB’s, RCCB’s	M/s. Legrand/ L&T /Siemens/ Schneider Electric/ C& S Electric Limited OR Equivalent Make.
10.	L.T Power Capacitors	M/s. BHEL/ ABB/ Epcos/ CG Power Systems/ Universal Cables OR Equivalent Make.
11.	Variable Frequency Drives	M/s. Siemens/ ABB/ Schneider Electric OR Equivalent Make
12.	Cables	M/s. Universal Cables/ Polycab/ RPG/ KEI OR Equivalent Make
13.	Battery	M/s. Exide Industries/ AMCO/ HBL-NIFE/ Amararaja OR Equivalent Make

14.	Battery Chargers	M/s. Universal Instruments/ Amararaja/ Chabhi Electricals/ HBL-NIFE OR Equivalent Make
15.	Cable Trays	M/s. Indiana / Profab / Steelite Engineering Ltd/ PatniOR Equivalent Make
16.	Cable Termination Kits & Cable Jointing Kit	M/s. M-Seal (3M) / Raychem OR Equivalent Make
17.	Earthing Strip, and accessories	M/s. Indiana / Profab / Sadhana / Sterlite OR Equivalent Make
18.	11kV Cable termination	M/s Raychem/ REPL/ 3M OR Equivalent Make

Note:

Other Equivalent Makes, if offered are subject to Specific Approval by the EMPLOYER based on the Submission of the following documents by the bidder:

a) Copies of Type Test Certificate not older than 5 years for the items offered.

b) List of Clients to whom already the items have been supplied along with the year of Supply and Value of Orders.

c) Copies of Performance Certificate from the User for the items.

d) Copy of latest ISO/IS Certification for the Manufacturer.

e) Details of Manufacturing Facilities.

f) Turn Over of the Manufacturer for the past 3 years.

1.5 General and Particular Mechanical Requirements

1.5.1. Submersible Pump Set

A. General

Pumps and drives shall be rated for continuous duty and shall be capable of pumping the flow range specified in the specifications without surging, cavitations or excessive vibration to the limits specified. The pump shall meet maximum allowable shut off head. The pumps shall not overload the motors at any point on the maximum pump speed performance characteristic curve and the pump operating range within the limits of stable pump operation. The total

head capacity curve shall be continuously rising towards the shut off as flow decreases throughout the entire curve from run out to shut off head with the highest at shut off. Pump shall be compatible for Variable Frequency Drive usage.

Its total head capacity curve shall be continuously rising towards shut off with the highest at shut off, and its capacity shall meet to handle total water volume.

(a) Pumps shall be suitable for single as well as parallel efficient operation at any point in between the maximum and minimum system resistances.

(b) Pumps shall run smooth without undue noise and vibration, cavitations, oil or water leaks over the range of operation. To ensure vibration free operation, all rotative components of pump shall be statically and dynamically balanced to BS 6861 as per zones A& B of ISO 10816 -1

(c) Vibration levels shall not exceed the levels given in BS 4675.

(d) The pump set shall be suitable for starting with discharge valve open and/or closed.

(e) The pump set shall be capable of withstanding the accidental rotation in reverse direction.

(f) The pumps shall be suitable for vertical, portable suspended/ bottom rested installation will be of suspended type design by column pipes/Horizontal installed. The pumps shall be installed in existing cut out available on Ground Level Reservoir roof top, in vertically suspended position. The scope of works shall be inclusive of the Pump-motor sets with necessary supporting arrangements. The bidder can select the type of pump based on the existing cut out size available on the GLR and complying to the minimum requirements data & material of construction specified below in the table, by which the pump set can be installed easily without making any much changes in the GLR roof slab. The total pump set shall be lifted and lowered from the existing cut out available with sufficient clearance.

(g) Total Side water depth of GLR is of 6.0 m, pump set selected shall be capable to work when side water depth availability of 1.2 to 1.8 m in the GLR without any hindrance.

(h) Totally 4 pump sets has been proposed at this GLR campus location out of which two pump sets shall be installed in each compartment of the GLR.

(i) The shut off head of pump shall be Minimum 110% to Maximum 130% of the specified head.

B. Features of Construction

(a) Pump shall be centrifugal, vertical spindle, non-clog, wear resisting and Compact single unit construction. Impeller shall be of single/multistage type.

(b) Pump casing shall be of robust construction. Liquid passages shall be finished smooth and designed as to allow less wear and tear. The volute tongue shall be filed to a smooth rounded edge.

(c) Double Mechanical seals (back to back) shall be provided to protect the motor from ingress of sewage along the shaft. And they shall be equipped with an electrical monitoring system for seal failure detection& moisture sensor shall be installed. Seals must be capable of withstanding rotation in either direction.

(d) The Impeller shall be of high efficiency enclosed type with smooth blunt edges and large water ways so as to allow free passage of water. It shall be free from sharp corners and projections.

(e) The critical speed of the rotor shall be at least 30% above the operating speed.

(f) Pump-sets shall have double bearings. Bearings shall be of the anti-friction type. Bearings shall be capable of taking the static weight of the rotating parts and any thrust generated by the operation of the pump. The Shaft shall be supported by heavy duty Ball or Roller bearings grease lubricated in accordance with BS 5512.

(g) The pump shall be fitted directly with a Heavy duty Suction Strainer.

Pump parameters are to be achieved at the motor speed corresponding to the frequency of 50 Hz.

Material of construction:

	Component	**Material**
a)	Pump casing	Cast Steel ASTM A 216 Gr.WCB
b)	Motor Casing	Cast Steel ASTM A 216 Gr.WCB/ IS 210 Gr. FG 260,
c)	Impeller	Stainless Steel: ASTM A 743 CF8M
d)	Shaft	Stainless Steel: BS 970 Gr. 410
e)	Mechanical Seal	Preliminary seal: Silicon Carbide v/s Silicon Carbide or Tungsten Carbide v/s Tungsten Carbide Secondary seals: Carbon v/s Silicon

	Component	Material
		Carbide or Tungsten Carbide
f)	Suction Stainer	Stainless Steel SS 304
g)	Lifting Chain	Stainless Steel SS 304
h)	Bearing	Ball Bearings
i)	Suspended Stand (Vertical) / Horizontal Base Frame	MS Fabricated Epoxy painted
j)	Wearing Rings (Suction Head Casing & Impeller)	Stainless Steel SS 316 or Bronze IS 318 Gr. LTB2
k)	Fasteners, Anchors bolts, Foundation Bolts etc. both in wet and dry areas:	Stainless Steel : SS 316

Inspection and testing

1.5.1 Inspection of Material to be procured

Inspection and certification of all materials used on the works such as MS Plates / Pipes and Specials , Valves, Cement, Size Stones, Sand aggregate, Lead, Rubber gaskets etc., for conformity with specifications of BIS. If insisted, inspection of materials at the manufacture place shall be arranged by the contractor at his cost including the travelling and accommodation of the inspecting officer.

1.5.2 **Inspection and certification of the various components of works.**

Construction of MS pipeline with all fixtures, construction of Valve Chamber including back filling of trench in layers with compaction as specified to ensure that all components of works are carried out as per specification and to required standards.

Inspection & Certification of Hydraulic Test on Completed pipe line in reaches as specified.

II.5.3 Induction Motor (Submersible Pump)

A. Performance and Characteristics

a) The submersible motor shall conform to IS: 9283:1979 & IS 325. The motors shall be suitable for operating on a 415 V, 50 Hz, 3 phase, AC supply. Pump motor shall be of the squirrel cage submersible type, protected to IP 68.Motor for submersible pump shall be capable of start up and operation in the event of a

completely flooded in sump. Motor cooling for submersible pump must be achieved by a cooling jacket, using the pumped media to cool the motor. The pump impeller must be equipped with a system to ensure a pumped flow of liquid through the cooling jacket and also incorporate a device to prevent the liquid channels from blocking with hair and foreign material. This motor shall be capable of starting 10 times per hour. The insulation class of motor winding shall conform to class F or H. Additionally the specific requirements mentioned in the following clauses shall also be met. The motor efficiency level shall be of IE 2 class.

b) Motors shall be capable of giving rated output without reduction in the expected life span when operated continuously under the following supply conditions :

(i) Variation of supply voltage from rated motor voltage ±10%

(ii) Variation of supply frequency from rated frequency ±5%

(iii) Combined voltage and frequency variation +10%

c) The starting current of motor shall not exceed 200% of rated full load current for star/delta starting and 600% of rated full load current for DOL starting, under any circumstances.

d) Motors shall be suitable for full voltage direct-on-line starting or star-delta starting. All the motors shall be VFD Compatible.

e) Motors shall be capable of starting and accelerating the load with the applicable method of starting, without exceeding acceptable winding temperatures, when the supply voltage is in the range 85% of the rated motor voltage to maximum permissible voltage.

f) The locked rotor current of the motor shall not exceed 600% of full load current (subject to tolerance as per the applicable standard) unless otherwise specified.

g) Motors shall be designed to withstand 120% of rated speed for two minutes without any mechanical damage, in either direction of rotation. The motor vibrations shall be within the limits

specified in applicable standard unless otherwise specified for the driven equipment.

h) Except as mentioned herein, the guaranteed performances of the motor shall be met with tolerances specified in applicable standard, IS: 9283-1979.

i) Motor insulation shall conform to Class F or H and the maximum temperature rise shall not exceed 95 deg C, when measured by winding resistance method and 85 deg C, when measured by thermometer method for an ambient temperature of 45 deg C. The motor windings shall be protected with a waterproof material and shall incorporate a thermal sensor in each phase to safe guard against high winding temperatures. The thermal sensor shall be connected into the control circuit of the starter and signals taken for continuous monitoring of winding temperatures. The motor shall incorporate a cut out device to detect the presence of any liquid in the motor enclosure, in the form of non resetting moisture switch. The terminal connections for the power and protective circuits shall be housed in a completely sealed and water proof junction box, complete with all external corrosion resistant cable glands. The pump units shall be provided with power and protection circuit cables of sufficient length to reach from the motor junction box to the local isolator located at the panel floor level. The local isolator shall be suitable for termination of power cables of adequate size from the starter panel/MCC panel.

j) Protection against increase in stator winding temperature (150 0C) bearing temperature, leakage in stator housing and terminal box shall be provided. Minimum three number thermistors in series are to be provided to sense the stator winding temperature. Sensors are to be provided to detect if leakage of sewage into the oil housing is above 30 % concentration.

k) Bimetallic thermal switch to trip the motor against increase in temperature shall be provided.

l) The power rating of the motor shall be larger of the following:

   (i) 115% of the power input to the pump at duty point at a speed corresponding to the frequency of 50 Hz.

   (ii) Maximum Power input while operating single pump corresponding to the speed of 50 Hz.

m) Motor shall be offered for routine and type tests in accordance with IS: 4029 and IS: 325 at the manufacturer’s works.

B. Submersible Cable

(a) The submersible cable shall conform to IS: 9283 and the relevant cable standards. Power cables shall be PVC insulated and PVC sheathed, Copper conductor cables. Cables shall be able to with stand abrasion, prevent ingress of water along the interstices of the cable and be resistant to acidic fluids and chemicals. Size of the conductor shall be adequate for continuous use under water and air. The half core shall be used for earthing.

(b) The control cable shall be PVC insulated PVC sheathed, flexible, flat type and shall be adequate for continuous use under water and air. The control cable for stator winding temperature sensor (Thermistors) 3 core x 2.5 sq. mm copper conductor and for bimetallic thermal switch 2 core x 2.5 sq. mm copper conductor shall be provided.

(c) In case a joint is required to be made between the lead cable supplied with the motor and the user's cable connectors, a detailed procedure of cable jointing to make a watertight joint shall be provided by the manufacturer.

(d) The size of the conductor and length of cable should be suitably selected so that the voltage drop at motor terminals does not exceed 3 percent of the rated voltage.

C. Earthing

Earthing of the motor shall be done in accordance with the relevant provisions of IS: 3043. For the purpose of earthing these motors, earthing connection may be made to discharge pipe.

D. Insulation

(a) Any joints in the motor insulation such as at coil connections or between slot and end winding sections, shall have strength equivalent to that of the slot sections of the coil.

(b) The insulation shall be given tropical and fungicidal treatment for successful operation of the motor in hot, humid and tropical climate. The tropicalising treatment shall be as per the applicable standard.

(c) The stator winding shall be made from high conductivity annealed copper conductor, PVC insulated winding wires conforming to IS 8783:1978 for wet type motors. The stator winding shall be of high conductivity annealed copper enameled insulated wires conforming to IS: 4800 (Part-VII):1970 for dry type motors.

E. Temperature Rise

The temperature-rise test of the motor shall be taken with the motor coupled to the suitable pump to give the full load output of the motor. When the various temperatures are stabilized, the set is stopped and the temperature-rise of the stator winding by the resistance method shall not exceed 35°C. During the test, the temperature of the cooling

water may not exceed 35°C. As the cable resistance will also be substantial, it is necessary that while calculating the temperature rise by resistance method, due care is taken to account for the correct hot and cold resistance of windings.

F. Constructional Features

The motor shall be suitable for continuous use in fully or partially submerged condition. A built in cooling system must allow the motor to operate continuously at its rated output regardless of whether the electric motor is submerged or not, by providing either external or internal cooling arrangement.

1.5.2. Valve

General

(a) Valves shall be as per internationally recognized standards. as per IS 14846,Body,Bonnet in DI IS 1865 Gr.500/7 & wedge shall be fully EPDM rubber encapsulated on DI IS 1865 Gr.500/7,Spindle in SS 431/420,Fasteners in CS IS 1367 Cl 4.6/4.0.Flanges drilled to IS 1538 Table 4 & 6

(b) All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

Data:

Sr. No.	**Description**	**Particulars**
(a)	Size (mm)	As defined in the respective BOQ
(b)	Quantity	As defined in the respective BOQ
(c)	Pressure Rating (bar)	As defined in the respective BOQ
(d)	Type of Operation	As defined in the respective BOQ
(e)	Type of Operation Mot – Motorised Man – Manual	As defined in the respective BOQ

Sr. No.	Description	Particulars
(f)	Size of Bypass (mm)	10% of main valve size

Material of Construction:

Sr. No.	Component	Material
(a)	Body	Ductile Iron IS 1865 Gr.500/7
(b)	Disc	Ductile Iron IS 1865 Gr.500/7
(c)	Shaft	Stainless Steel; BS 970 Gr. 431 S29 / ASTM A 276 Gr. 431
(d)	Body Seat Ring/Seal retaining ring	Stainless Steel; ASTM A 743 CF8
(e)	Bearing	Stainless Steel backed Teflon
(f)	Disc seal	Food Grade EPDM
(h)	Internal & External Fasteners	SS 316

Electric Actuator

(a) Electric actuators shall consist of followings:

i. AC electric squirrel cage motor with high torque, low inertia, with class F insulation and temperature rise limited to class B.

ii. Thermistor embedded within motor windings to prevent damage due to overload.

iii. Reduction gear unit.

iv. Torque switch mechanism.

v. Limit switch mechanism.

vi. Valve position indicator.

vii. Valve position transmitter

viii. Continuous Local Indicator

ix. Hand Wheel for manual operation

x. Manual-auto lever with locking arrangement.

xi. Space heater for enclosure

xii. Earthing terminals

(b) All local controls shall be protected by a lockable cover.

(c) Each actuator shall be adequately sized to suit the application and be continuously rated to suit the modulating control required. The gearbox shall be oil or grease filled, and capable of installation in any position. All operating spindles, gears and headstocks shall be provided with adequate points for lubrication.

(d) The valve actuator shall be capable of producing not less than 1½ times the required valve torque and shall be suitable for at least 15 minutes continuous operation.

(e) The actuator starters shall be integrally housed with the actuator in robustly constructed and totally enclosed weatherproof housing. The motor starter shall be capable of starting the motor under the most severe conditions.

(f) Integral reversing contactor starter complete with three element ambient temperature compensated overload relays of suitable range, with adjustable setting and built-in single phasing preventor and adequately rated control fuses.

(g) Integral reversing contactor starter shall be suitable for 60 starts per hour and of rating appropriate to motor size. Actuators with solid state Motor Reverser suitable for modulating service shall be up to 1200 starts per hour.

(h) The starter housing shall be fitted with contacts and terminals for power supply, remote control and remote positional indication, and shall also be fitted with internal heaters so as to provide protection against damage due to condensation. Heaters shall be suitable for single phase operation. The heaters shall be switched “ON” when the starters are “OFF” and shall be switched “OFF” when the starters are “ON”.

(i) Each starter shall be equipped as follows :

- 2 Nos. Three phase magnetically operated line contactors with no-volt release and electrical and mechanical interlock.
- 1 No of Three phase thermal cut-out device.
- 1 No. of AC Control circuit transformer fully protected by fuses on primary and Secondary circuit.
- 1 No. Set of “Open”, “Close” and “Stop” buttons.
- 1 No. of Local- Off-Remote switches with padlocking facilities.
- 1 No. of Set of torque and limit switches for “open” and “Close” positions.
- 3 Sets of auxiliary limit switches in each direction.
- Valve position indicator and hand wheel for manual operation.
    - A white lamp for supervision of main supply. To be provided locally.
    - A potential free contact shall be provided to annunciate over load trip / main supply failure on remote panel.
    - A blinker relay and lamp shall be provided such that the lamp shall blink as long as the actuator is running; either to close or to open position.

(j) Reduction gear unit:

Gearbox shall have a life of 1, 00, 000 hours, be selected in accordance with AGMA recommendation for horsepower calculation and service factor application.

(k) Tests:

The routine and acceptance tests specified in standards shall be conducted on each valve actuator. Insulation resistance test (Meggering) using 1000V megger for power terminals and 500V megger for control terminals, High voltage test at 1.5 kV AC for 1 sec.

Sluice Valves

(a) All the Sluice valve shall be of resilient seated, glandless design generally confirm to BS 5163 -89/ IS 14846 -2000.Face to Face dimension shall be as per IS 14846-2000 only.

(b) Flanges shall be machined on faces and edges and drilled to IS 9523/IS 1538/BS EN 1092-1 based on the pipe drilling standard shall be adopted. Sluice valves shall be of non-rising spindle type.

(c) Sluice valve provided in all location of usage shall be only resilient seated.

(d) All valves, spindles and Hand Wheel shall be positioned to give good access for operational personnel. Valve buried or installed in underground chamber, where access to a hand wheel would be impractical, shall be operated by means of extension spindle and/or keys. Valve shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.

(e) All hand wheels shall be arranged to turn in a clockwise direction to close the valve, the direction of rotation for opening and closing being indicated on the hand wheels.

(f) Manufacturer is required to give details of proposed gear box i.e. nos. of spur pairs, ratio,efficiency etc. The Employer shall have these tested.

(g) The Valves shall be painted with Electro static epoxy powder coating both inside and outside with pocket less body passage for a minimum DFT of 250 Microns.

(h) Manufacturer is required to give justification with calculation that proposed valve is operable with the effort parameters specified and no. of turns to ensure the time required to operate the valve from full open to full close is within reasonable limits.

Data:

Sr. No.	Description	Particulars
(a)	Size (mm)	As defined in the respective BOQ
(b)	Quantity	As defined in the respective BOQ
(c)	Pressure Rating (bar)	As defined in the respective BOQ
(d)	Type of Operation	As defined in the respective BOQ
(e)	Type of Operation Mot – Motorised Man – Manual	As defined in the respective BOQ

Material of Construction:

S. No.	Component	Material
(i)	Body & Bonnet	SG Iron IS 1865 Gr. 500/7 or Gr. GGG50
(ii)	Doors/Wedge	SG Iron IS 1865 Gr. 500/7 or Gr. GGG50 Rubber lined with EPDM Food Grade quality
(iii)	Spindle	Stainless Steel: BS:970 Gr 431 /420
(iv)	Thrust collar & Wedge Nut	Bronze : IS:318 Gr LTB2
(v)	Internal& External Fasteners	Stainless steel AISI 316
(vi)	Seals	Food Grade EPDM
(vii)	O-Rings	NBR

All Sluice valves shall be open end tested.

Non-Return Valve

(a) Type of Valve:

- On the individual delivery line of the pump up to 300 mm, Ductile Iron double flanged swing check valves with slanted seat or with lever weight with straight disc, with metallic corrosion proof and wear resistant seal faces with nickel overlay micro-finished with body and disc in Ductile Iron of minimum grade GGG-40, shaft of stainless steel and bearings of zinc free bronze and surface protection with epoxy liquid of GSK quality.

- On the individual delivery line of the pump & common discharge header above 300 mm, Ductile Iron double flanged, Tilting disc Swing Check Valves Slanted seated with maximum swing of 59 degree with metallic, corrosion proof and wear resistant seat faces, Body and Disc of ductile cast iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2, Shafts of stainless steel SS 420/410, shaft bearing of zinc free bronze and Integral body seat face & disc face with nickel-chromium overlay welding and micro finished. All the inside and outside of the body is to be coated with double coating of food grade epoxy liquid lacquer (EP-F) with minimum thickness of 250 microns, color: RAL 5005 Blue face to face dimensions according to EN 558-1/14/DIN 3202-F4, Flange dimensions according to EN1092-2/IS 1538 With Bypass arrangement or Multi-door swing type IS 5312 Part-II (With

Bypass) the valve shall be accepted based on the diameter of the pipe.

- The valves shall be suitable for mounting on a horizontal pipeline and flow direction shall be clearly embossed on the valve body.
- Valves shall possess high speed closing characteristics and be designed for minimum slam condition when closing.

Data:

Sr. No.	**Description**	**Particulars**
(a)	Size (mm)	As defined in the respective BOQ
(b)	Quantity	As defined in the respective BOQ
(c)	Pressure Rating (bar)	As defined in the respective BOQ
(d)	Type of Operation	As defined in the respective BOQ
(e)	Type of Operation Mot – Motorised Man – Manual	As defined in the respective BOQ
(f)	Size of Bypass (mm)	10% of main valve size

The material of construction of Multi-door swing check valve shall be as follows:

S. No	**Component**	**Material**
	Body and Door	Ductile Iron IS 1865 Gr. 500/7
	Body and Door Ring	Stainless Steel : ASTM A743 CF8M/SS316
	Hinge Pin	Stainless Steel : BS970 431 S29
	Bearings Bush	Stainless Steel backed Teflon
	Internal Fasteners	SS 316
	External Fasteners	SS304

Air valve

The Air Valve shall be of tamper Proof triple function Single/Double chamber Kinetic Air Valve. The valve shall be capable of exhausting air form pipe work automatically when being filled. The air being released at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly the valve shall be capable of ventilating pipe work automatically when being emptied, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines. The valve shall also automatically release air accumulating in pipe work during normal working conditions. In case the maximum size, as per ISS, is not suitable for the size of pipe line, a cluster of air valves shall be provided.

Air valve shall be of the double orifice Tamper Proof Kinetic Air valve type with a large orifice for venting of large air volumes on start up. Large orifice for intake of large air volumes during vacuum.Small orifice for discharge of pressurized air during operation. The valve shall be suitable for the maximum working pressures in the systems. All air valves shall be provided with isolating valve and flanged end connections.

Air valve shall be designed to prevent premature closure prior to all air having been discharged from the line. The orifice shall be positively sealed in the closed position but the float (ball) shall only be raised by the liquid and not by a mixture of air and liquid spray. The seating shall be designed to prevent the floats sticking after long periods in the closed position.

Data:

	Description	**Particulars**
	Size (mm)	As defined in the respective BOQ
	Quantity	As defined in the respective BOQ
	Rating (bar)	As defined in the respective BOQ

Material of Construction:

Sr. No.	**Component**	**Material**
	Body/Top Cover	Ductile Iron Gr. GGG40/ GGG-50
	Small orifice Plug	Leaded Tin Bronze IS 318 Gr.

Sr. No.	Component	Material
		LTB 2
	Seat Ring	Leaded Tin Bronze IS 318 Gr. LTB 2
	Float/Balls	SS AISI 304
	Cover Bolts	SS316
	Gaskets & Seals	Food Grade EPDM

Pressure Relief Valve

Pressure relief valves shall be capable of relieving pressure in the system to prevent the system being pressurized in excess of a preset maximum allowable pressure. The valves shall be drop tight under normal operating conditions.

(a) The valve operation shall be achieved by the interaction of the inlet pressure and an intermediate pressure produced by a pilot valve or relay system acting on the upper side of the main valves.

(b) The pilot valve or relay system shall be actuated by a diaphragm connected to the inlet pressure on its underside and a constant pressure on its upper side derived either from weight or from a spring.

(c) All Pressure Relief Valve shall be provided with isolating valve and flanged end connections.

Data:

Sr.No.	Description	Particulars
(a)	Size (mm)	As defined in the respective BOQ
(b)	Quantity	As defined in the respective BOQ
(c)	Rating (bar)	As defined in the respective BOQ

Material of Construction:

Sr. No.	Component	Material
(a)	Body/Top Cover	Cast Steel : ASTM A216 Gr. WCB/ Ductile Iron Gr. GGG40/ GGG-50
(b)	Piston and Cylinder,Pilot valve	Gun Metal: BS 1400 LG2/Brass IS 318 Gr. LTB 2
(c)	Spindle and Piston rod	Stainless Steel : BS 970 431 S 29
(d)	Spring	Spring Steel SS 302
(e)	Diaphragm	Nitrile Rubber
(f)	Tubing	SS 316

Expansion Bellows:

Expansion bellows of Stainless steel (AISI 304) confirming to EJMA standards which can take radial and axial misalignment of minimum 1 percent of pipe size with tie rods. Bellows shall be of Flange Ends, thickness of the ends shall be same as pipe thickness to match inner and outer diameter of the pipeline. Suitable Mild Steel protection cover shall be provided across the bellows against any external tampering for outdoorinstalltion. It shall have cyclic life more than 1000 cycles and designed at temperature of 50 deg C. Hydro test shall be conducted at 1.5 times that of the design pressure with a holding time of 30 minutes. Painting shall be of 2 coats of Red oxide and 2 coats of Epoxy primer to achieve minimum DFT of 250 microns of suitable shade with prior approval of the Engineer. Calculation confirming to EJMA standards shall be submitted for the selection number of ply and thickness of the bellows.

Data:

Sr.No.	Description	Particulars
(a)	Size (mm)	As defined in the respective BOQ
(b)	Quantity	As defined in the respective BOQ
(c)	Rating (bar)	As defined in the respective BOQ

Material of construction:

Sr. No.	Description	Material
(a)	Bellows	Stainless steel AISI 304
(b)	Flange ends	Mild Steel IS 2062 Gr.B
(c)	Tie Rods	Mild Steel IS 2062 Gr.B(Electro plated)
(d)	Nuts & Lock Nut	Mild Steel IS 2062 Gr.B(Electro plated)

II.5.4 Manual Hoist

Manual hoists shall be complete with hand-chain, trolley, pulley block, hook, hand and load chains, brake and other accessories. They shall comply with the latest applicable standards, regulations and safety codes in the locality where equipment will be installed.

Each hoist shall be operated on a monorail (I-Beam). The factor of safety shall not be less than 5. The load chain may be heat-treated to give ductility, toughness and conforming to I.S. 3109/B.S. 1663 /B.S. 3114. The load wheel is to be made from heavy duty malleable castings. The hand chain is to Conform with B.S. 6405:1984 and hand chain wheel may be made from pressed sheet steel with roller type guarding. Gears shall be cut from solid cast or forged steel blanks or shall be stress – relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, Quality of Steel, heat treatment, face, pitch of teeth and design shall confirm to BS-436, BS-545 and BS-721. Spur and helical gears must comply with B.S. 436 and worm with B.S. 721. Bearing must be ball and roller type conforming to I.S. 2513/B.S.2525-32:1954.Proper lubricating arrangements are to be provided for bearings and pinions. The brake for the lifting gear shall be automatic and always in action.

If the offered pump/motor weight is more than the crane capacity specified, the Contractor shall offer the hoist capacity higher than the weight of the pump/motor.

The proof testing of each chain pulley block is to be carried out as per latest applicable standards. The safe working load is to be marked in such way that is clearly visible from the operating level.

Name Plate showing the capacity, year of manufacture and rated capacity of hoist in figures not less than 150 mm height shall be placed on each side of the hoist girder.

Two pairs of slings and wire ropes, shackles, etc shall be supplied to handle all items of pumping station covered by the hoist. They shall

be labelled or marked with the Safe Working Load (SWL) and the purpose for which they are intended.

The crane, and all slings, ropes, shackles and other lifting equipment supplied shall be tested by the manufacturer at his works. The tests shall be carried out at 125% of Safe Working Load, and Test Certificates shall be supplied.

III. Note: - The pump sets shall be lifted and lowered by using Jib crane post with 360 degree swing arrangement (I-girder section) with manual chain pulley block shall be made at site on either side of the GLR where pump is installed. BOQ rate shall include **Fire Extinguishers**

Portable fire extinguishers are to be provided for all units as per the requirement of Tariff Advisory Committee (TAC) or meeting the requirement of local regulations whichever is stringent. All the extinguishers shall have ISI mark / TAC approved.

IV. Propeller Exhaust Fan

The fan should comply with IS 2312.

The blades shall be of mild steel and properly balanced so as to avoid noise and vibration. The blade and blade carriers shall be securely fixed so that they do not loosen in operation. The means provided for securing the fan mounting or fan casing to the wall, partition or window shall be such as to provide a secure fixing without damage to the fan or wall.

Suitably designed guards shall be fitted to the inlet and the outlet side to prevent accidental contact. No flammable material shall be used in the construction of fan. Moulded parts, if used, shall be of such materials as to withstand the maximum temperature attained in the adjacent component parts.

The fan shall have protective insulation or be capable of being earthed. A fan with protective insulation may be of all insulated construction or have either double insulation or reinforced insulation. Each fan should be provided with a 10 sq.mm mesh bird screen. The sheet used for the cowl should be 14 G.

V. Forced Fresh Air Circulation System

Fresh air circulation system is to be provided for the pump house for circulation of fresh air to limit increase in temperature and also avoid stale air presence. The complete system along with all associated required air supply fans, exhaust fans, ducts, grills, galvanized bird screens, hoods and all necessary accessories shall be provided. Suitable arrangements to prevent ingress of rain water into building shall also be provided. The system shall be designed with required air changes and the contractor shall provide detailed calculations to

determine the air capacity, static pressure etc. and relevant technical details for the approval of Engineer.

All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending of fabrication of ducts.

The ducts shall be fabricated from galvanized plain steel sheets conforming to IS: 277-2003. All duct work, sheet metal thickness and fabrication, unless otherwise directed, shall strictly meet requirements as described in IS: 655.

All joints shall be tight and shall be made in the direction of air flow. The ducts shall be reinforced where necessary and must be secured in place so as to avoid vibrations of the duct and its supports.

Volume control dampers shall be of an approved type, lever operated and complete with locking devices which will permit the dampers to be adjusted and locked in any position.

Exhaust fans of appropriate rating shall be provided for pumping stations. The contractor shall submit the fan selection details for approval.

For axial flow fans / propeller fans, speed limitation shall be as follows:

For impeller diameter of up-to 450 mm – maximum speed shall be 1500 rpm.

For impeller diameter above 450 mm – maximum speed shall be 1000 rpm.

Suitable designed guards shall be fitted to the inlet and the outlet sides to prevent accidental contacts. No inflammable material shall be used in the construction of fans.

Drive motors shall be rated at least 15% higher than the power requirement at duty point or 10% higher than the maximum power requirements at the selected speed, whichever is higher. Motor shall be suitable for 1-ph supply and conforming to TEFC, IP 54 protection.

VI. Noise & vibration

Noise level produced by any rotating equipment individually or collectively shall not exceed 85 dB (A) measured at a distance of 1.5 meters from source in any direction. The overall vibration level shall be as per zones A and B of ISO 10816-1. Balance quality requirements shall be G 6.3 conforming to ISO 1940/1.

VII. Air-conditioning Equipment

The air conditioning units shall be ceiling suspended. Both the units shall be located above the false ceiling provided in the control room. Ducting shall run continuously from the units with suitable collars at regular intervals for the outlet to supply air diffusers. Return air shall

be taken through 50 mm slit provided between the false ceiling and the side wall. Fresh air opening of size 250 mm x 200 mm on the side wall of the room above the false ceiling with wall cowl, bird screen and damper shall be provided. Outdoor condensing unit shall be mounted on the terrace of the room or grouted on external side of the wall with suitable brackets.

VIII. Manufacturer's Experience

All the equipment, to be supplied under this contract, i.e. Pumps. Electric motors, valves, Piping, Chlorination system, Electric Hoist & Cranes etc. have to be of very reputed makes. The equipment of only those manufacturers, who have sufficient proven experience of manufacturing the respective equipment of similar capacity as specified in the bid, shall be considered.

The respective equipment should have been manufactured, supplied, installed, commissioned successfully and should be running satisfactorily since at least last 5 years continuously. Certificates from the end users, regarding their satisfactory performances from reputed clients, Water Board (Government/Semi Government), shall have to be submitted in this regard.

Note:

Subject to Specific Approval by the EMPLOYER based on the Submission of the following documents by the bidder:

a) List of Clients to whom already the items have been supplied along with the year of Supply and Value of Orders.

b) Copies of Performance Certificate from the User for the items.

c) Copy of latest ISO/IS Certification for the Manufacturer.

d) Details of Manufacturing Facilities.

g) Turn Over of the Manufacturer for the past 3 years.

1.6 Instrumentation And Control Equipment

Engineer shall have the right to modify/alter the Particular Specifications and/or Standard Specifications at any time which promise to confer equal or better quality than the standard specified in the tender document. Such modification or alteration shall be acceptable to the Contractor subject to no additional financial burden to either the Contractor or the Employer.

1.6.1. Qualification Criteria

Qualification Criteria for Instrumentation vendor/integrator and Automation vendor/integrator:

The Manufacturers shall be operating under an accredited ISO 9001 or above Quality System. All hardware shall be of the most current technology and Versions from the Manufacturer. All hardware and software shall be from the system manufacturer.

The Instrumentation Manufactures / Suppliers shall be operating under an accredited ISO 9001 or above Quality System. The instrumentation supplier should have minimum 10 years of experience in India in the field of instruments supply and service. They should have branch locally for service support at Bangalore and should supply internationally reputed brands.

The HMI /Automation sub-contractor shall be a reputed System manufacturer or System integrator with a minimum of 10 years experience of having executed ICA projects within India or outside India and shall demonstrate capability and resources for integrating/interfacing control systems from different manufacturers as well as coordination with multiple agencies for contract execution. They should have branch locally for service support at Bangalore.

The system supplier must be an authorized system integrator for the named PLC hardware/HMI supplier. Verification certificates shall be submitted directly from the manufacturer of the PLC hardware supplier. In addition, submit references for minimum of (3) locations where the automation equipment has been successfully installed, including name, address and telephone number for the appropriate utility person to contact.

The system supplier must submit evidence that they employ in excess of 10 personnel, including no less than 5 technical staff to include engineers, programmers, and field technicians. Submit the qualification and license for a minimum of Three professional engineers in the direct employ of the system supplier Identify with resumes all personnel who may be assigned the specified project.

All hardware and software proposed shall have been successfully used in a similar water application for a period of at least five (5) years and be from established and reputable suppliers. Refer Approved Vendor Listin Particular Instrumentation requirements.

Upgrades and improvements to the manufacturers standard system that are released before the expiration of the warranty period shall be supplied, installed and commissioned at no additional cost.

These shall include all hardware and software necessary to implement the upgrade.

1.6.2. Instrumentation System Design Criteria

The design criteria to be applied to instrumentation systems shall be as follows:

(a) All instruments shall be suitable for continuous operation
(b) All transmitting instruments shall have a 4 - 20 mA linear output
(c) All digital outputs shall be volt free
(d) All instruments shall be designed for the ambient conditions of temperature and humidity
(e) All wetted parts of instruments sensors shall be non-corrosive and suitable for use with potable water containing residual chlorine
(f) All instrumentation systems for use out of doors shall be protected to IP 65 for sensors and transmitters, while enclosures under submersible conditions shall be protected to IP 68.
(g) instrumentation shall utilise solid state electronic technology and avoid the use where practical of any moving parts
(h) instruments shall resume operation automatically on application of power following a power failure
(i) All instruments shall be tropicalised.
(j) all software and hardware provided shall operate seamlessly at the millennium changeover and continue to operate there after without change in performance
(k) The instrumentation, control, automation by PLC/ HMI installations shall fully comply with design standards, regulations and the material and workmanship requirements of the Specification.
(l) The electrical plant installations associated instrumentation control and automation systems shall also comply with and be tested in accordance with the latest edition of BS 7671 or equivalent Indian standards.
(m) All equipment and materials incorporated in the system shall be selected, designed and rated to operate under the defined performance duties and specified site conditions and to maintain a high level of operational reliability.
(n) The instrumentation control and monitoring system equipment and materials shall have an operational life of not less than 15 years, unless otherwise approved by the Engineer.

<u>General Requirement of Instrumentation Control & Automation</u>

Instrumentation system shall be designed, manufactured, installed and tested to ensure the high standards of operational reliability. All electronic components shall be adequately rated and circuits shall be

designed so that change of component characteristics shall not affect plant operation.

All instrumentation equipment shall be new, of proven design, reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be tropicalised. The outdoor equipments shall be designed to withstand tropical rain. Wherever necessary space heaters, dust and water proof cabinets shall be provided. Instruments offered shall be complete with all the necessary mounting accessories.

Electronic instruments shall utilise solid state electronic components, integrated circuits, microprocessors, etc., and shall be of proven design.

No custom made hybrid type integrated circuits shall be used.

Unless otherwise stated, overall accuracy of all measurement systems shall be ±1% of measured value, and repeatability shall be ± 0.5%.

Unless otherwise specified, the normal working range of all indicating instruments shall be between 30% and 80% of the full scale range.

On resumption of the supply following a power failure the instruments and associated equipment shall start working automatically.

The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.

The field instruments i.e., the instruments mounted outside the control panel shall be mounted at a convenient height of approximately 1.2 metres above grade platform.

Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof to IP-65.

The instruments shall be designed to work at the ambient conditions of temperature, humidity, and chlorine contamination that may prevail but in any case not less stringent than those conditions detailed in the Project Requirements. Instruments shall be resistant to corrosion in the atmosphere in which they are expected to operate.

Lockable enclosures shall be provided for all the field mounted instruments.

All field instruments, and cabinets/panel mounted instruments shall have tag plates/name plates permanently attached to them. Details of proposed inscriptions shall be submitted to the Employers Representative for approval before any labels are manufactured.

All coated parts of sensors shall be made out of non corrosive material capable of working with chlorine content of 5 ppm.

For all instruments installed in the field, surge protection devices (SPD s) shall be provided at both ends of the connecting cable for protection against static discharges / lightning and electromagnetic interference.

1.6.3. Scope of Work

The following Control & Instrumentation shall be required at the pumping station

1. Electromagnetic Flow Meter at the common discharge outlet of the Pumping station.
2. Pressure indicating Transmitter at the common discharge outlet of the Pumping station
3. Pressure gauges on both suction and discharge side of the pump sets.
4. HMI based PLC system to control the pumping station
5. Alarm Annunciator to indicate the critical alarms and faults.
6. Ultrasonic Level indicating Transmitter for the GLR/Suction Sumps.
7. Conductivity Type Level Switches on GLR/Suction Sumps.

1.6.4. Approved Vendor List for Instrumentation

The naming of a manufacturer in this specification is not intended to eliminate competition or prohibit qualified manufacturers from offering equipment. Rather, the intent is to establish a standard of excellence for the material used, and to indicate a principle of operation desired.

i. List of Makes for Instrumentation

SL NO	DESCRIPTION	VENDOR/ MANUFACTURER/ MAKE
1	Flow meters/Flow Indicator/ Transmitter	M/s EMERSON M/s ABB M/s Siemens M/s Yokogawa M/s Endress+Hauser

SL NO	DESCRIPTION	VENDOR/ MANUFACTURER/ MAKE
		M/s Forbes Marshall
2	Pressure Gauges	M/S General Instruments M/S H Guru M/s Wika M/s AN Instruments M/s Kobold M/s Forbes Marshall M/s Endress+Hauser
3	Pressure/Radar & Ultrasonic Level Indicator Transmitter	M/s EMERSON M/s ABB M/s Kobold M/s Siemens M/s Endress+Hauser M/s Forbes Marshall
4	Level Switch	M/s Siemens M/s Endress+Hauser M/s Forbes Marshall M/s Shridhan International M/s ABB M/s Pune Techtrol

ii. List of Makes for UPS & Batteries:

(a) List of Makes for UPS

S. NO	MANUFACTURER / MAKE
1	M/s APC
2	M/s DB & ELECTRONICS
3	M/s HI-REL
4	M/s NUMERIC POWER SYSTEMS

(b) List of Makes for Batteries

S. NO	MANUFACTURER / MAKE
1	M/s AMAR RAJA
2	M/s HBL NIFE
3	M/s AMCO
4	M/s EXIDE

iii) List of Makes for Cables

S. NO	MANUFACTURER / MAKE
1	M/s Universal Cables

2	M/s Polycab
3	M/s Havell's
4	M/s CCI
5	M/s Finolex
6	M/s NICCO
7	M/s Delton Cables Limited

1.7 Storage of Materials and Plant

1.7.1 The Contractor shall provide appropriate storage facilities for materials like cement, steel, aggregates, consumable supplies, equipment, mechanical and electrical items, etc., and shall take all safety and security measures against theft and deterioration in quality, at his own cost.

1.8 Procurement of Materials:

1.8.1 CEMENT:

The Contractor shall use only 43 grade cement conforming to IS 8112 / 89 with latest amendments with ISI mark. The Contractor should furnish the manufacturer test certificate for the above brand of cement for having manufactured the cement as per relevant BIS and guarantee certificate before using the cement.

1.8.2 STEEL:

The Contractor shall procure the steel from VISL / SAIL / VSP / TISCO and manufacturers' test certificate is to be produced.

1.8.3. MS PIPES, VALVES AND OTHERS

Sl.No.	Description	Some of the makes preferred.
1	Sluice Valves Conforming to IS 14846/2000	KIRLOSKAR, IVI, BSJ, HAWLE Valves, AVK Valves , McWane India Pvt Ltd.,Valves
2	Butterfly valves – Conforming to IS 13095 / 1991	KIRLOSKAR, IVI, BSJ, HAWLE Valves, AVK Valves , McWane India Pvt Ltd.,Valves
3	MS plate/HR coil to Manufacture MS pipes Conforming to IS: 2062	SAIL, TISCO,ESSAR STEEL, ISPAT Industries,
4	Kinetic Air Valves	KIRLOSKAR, IVI, BSJ, HAWLE Valves, AVK Valves , McWane India Pvt Ltd.,Valves
5	Double Ball Kinetic Air Valves	KIRLOSKAR, IVI, BSJ, HAWLE Valves, AVK Valves, McWane India Pvt Ltd., Valves
6	Bolts, Nuts and Washers	GKW, TEXSO MAKE, T.V.S. UNBRAKO

The above branded makes are preferred. Any other reputed make as may be approved by BWSSB at a later date by producing the credentials.

QAP to be submitted for the approval to the employer.

1.9 Equivalency of Standards and be procured, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards which ensure an equal or higher quality than the standards and codes specified will be acceptable subject to the Engineer's prior review and written approval. Differences between the standards specified and the proposed alternative standards must be fully described in writing by the Contractor and submitted to the Engineer at least 28 days prior to the date when the Contractor desires the Engineer's approval. In the event the Engineer determines that such proposed deviations do not ensure equal or higher quality, the Contractor shall comply with the standards specified in the documents.

1.10 Sign Board

1.10.1 The Contractor shall provide a sign board at the site of the Works of approved size and design which provides (i) the name of the Project (ii) the names and addresses of the Employer, the Contractor and the Consultant; (iii) the name and short description of the Project, (iv) the amount of the Contract Price ; and (v) the starting and completion dates.

1.11 Samples and Tests

1.11.1 The Contractor shall be responsible to develop a quality control program and to provide all necessary materials, apparatus, instruments, equipment, facilities and qualified staff for sampling, testing and quality control of the materials and the works under the Contract. Without limiting the generality of the foregoing, the Contractor shall either (i) establish a testing laboratory at the site of Works which is adequately equipped and staffed to carry out all sampling and testing in accordance with the requirement set out in the General Specifications and/or these Special Specifications and provide all field equipment and apparatus as necessary to conduct all specified in-situ tests and/or any Tests on Completion, provided the correctness of the equipments are ensured or (ii) arrange for routine sampling, testing and reporting, as required, through a certified independent testing laboratory acceptable to the Engineer. All costs of such sampling, testing and reporting of test results will be borne by the Contractor, and the Contractor shall include sufficient provisions in his tendered rates to allow for independent sampling and laboratory testing under the direction of the Engineer up to 5% of the required tests at no additional cost. The Contractor shall furnish certified copies of all test reports to the Engineer within 3 days of completion of the specified tests.

1.11.2 The Contractor shall, within 14 days after the date of the Letter of Acceptance, submit to the Engineer for his consent a detailed description of the arrangements for conducting the quality control program during execution of the Works, including details of his testing

laboratory, equipment, staff and general procedures. If following submission, or at any time during the progress of Works, it appears to the Engineer that the Contractor's quality control program is not adequate to ensure the quality of the Works, the Contractor shall produce a revised program which will be adequate to ensure satisfactory quality control.

1.12 Protection of Utilities

1.12.1 The Contractor is required to carefully examine the location of the Works and their alignments and to make special enquiries with all authorities concerning all utility lines such as water, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead) lines, etc.; and to determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities as may be required, and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. If any major shifting or realignment of water, sewers, gas pipes, electric and telephone lines is necessary due to their interference with the proposed Works, the same may be done by the Employer. The cost of such relocation will be borne by the Employer. In case the alignment of the pipeline crosses high tension electrical transmission lines belonging to the Karnataka Power Transmission Corporation Ltd. (KPTCL) or other authorities, the Contractor shall take all precautions necessary to see that the work is carried out with care and safety, without disturbing such transmission lines. The Contractor will be responsible to carry out all construction activities in such reaches in consultation with the owners of such facilities. However, satisfactory completion of the entire work will be the responsibility of the Contractor.

1.13 Construction Methodology

1.13.1 Tenderer shall submit the detailed construction methodology along the clear program of works while submitting the tender. The methodology shall include the safety measures to be adopted in the execution of work. Tenderer shall express in detail the methodology for addressing the Social & Environment factors during the execution of work.

1.14 Inspection and testing

1.14.1 Inspection of Material to be procured

Inspection and certification of all materials used on the works such as DI Pipes and Specials , Valves, Cement, Size Stones, Sand aggregate, Lead, Rubber gaskets etc., for conformity with specifications of BIS. If insisted, inspection of materials at the manufacture place shall be arranged by the contractor at his cost including the travelling and accommodation of the inspecting officer.

1.14.2 **Inspection and certification of the various components of works.**

Construction of DI pipeline with all fixtures, construction of Valve Chamber including back filling of trench in layers with compaction as specified to ensure that all components of works are carried out as per specification and to required standards.

Inspection & Certification of Hydraulic Test on Completed pipe line in reaches and as a whole network as specified shall be carried out. The hydraulic testing of the pipelines is to be certified by the third party and the in charge BWSSB Engineer.

1.16 Technical Specifications

1.16.1 Engineer shall have the right to modify/alter the Particular Specifications and/or Standard Specifications at any time which promise to confer equal or better quality than the standard specified in the tender document. Such modification or alteration shall be acceptable to the Contractor subject to no additional financial burden to either the Contractor or the Employer.

1.17 Storage of Materials and Plant

1.17.1 The Contractor shall provide appropriate storage facilities for materials like cement, steel, aggregates, consumable supplies, equipment, mechanical and electrical items, etc., and shall take all safety and security measures against theft and deterioration in quality, at his own cost.

1.18. DI PIPES and D.I. Specials.

Sl. No.	**Description**	**Some of the preferred vendors.**
	DI Pipes	Electrosteel, Lanco Kalahasti, Jindal SAW, Tata, Electrotherm etc.,
	DI Specials	Electrosteel, Kiswok, Kezrival Castings Ltd., Zindal, Chandranchal etc.,

Any other reputed make as may be approved by BWSSB at a later date by producing the credentials.

QAP to be submitted for the approval to the employer.

1.19. For Bulk Flow Meters: As per the contract (BOQ).

The above branded makes are preferred. Board can specify any make among the above brands and rates quoted shall have provision for supply any make specified among the list. If contractor wish to procure material from any other reputed manufactures, prior approval of the Board is required and can be obtained by requesting the Board along with the credential of such manufacture and standards of the material intended for procurement.

II EARTH WORK:

2.1 GENERAL:

2.1.1 The earth work excavation for laying of pipe shall be carried out. The Contractor should use concrete / asphalt cutting machines strictly for asphalt cutting and concrete surface cutting and the width of cutting should not exceed the required approved width. The adjoining surface should not be damaged while excavation. i.e. use of JCB excavator is limited and without haphazard width excavation

The Contractor shall make all excavations required for laying and jointing of the pipeline and construction of pertinent structures as required in the project. Except where otherwise required by the project or instructed by the Engineer, all excavation shall be in open cut to the specified widths and depths. The Contractor is advised to satisfy himself with regard to the likely conditions that may be met with during the execution of the Works, with regard to the underground obstructions or conditions, necessary dewatering requirements etc. Before commencing the earth work, the Contractor shall carry out detailed survey of the proposed alignment, prepare construction drawings showing the longitudinal section of the ground profile, locations of valves and other appurtenances and submit to the Employer for approval.

2.2 CLASSIFICATION OF EXCAVATION

All materials involved in excavation shall be classified in three categories as follows:

2.2.1 **Ordinary soil:** This includes excavation in all types of soil including soil containing gravels, murrums, loose boulders, viz., ordinary gravely soil, hard gravely soil, wet soil, stiff slushy soil, chettu soil and calcareous strata, but exclusive of disintegrated rock, soft rock/shale;

2.2.2 **Soil Containing Disintegrated Rock, Soft Rock and Soft Shale:** This category includes excavation in soil containing disintegrated rock, soft rock or soft shale which can be cut by shovel and no hand or mechanical chiseling is required.

2.2.3 **Medium Hard Rock:** This category includes excavation in lime stone, sand stone, hard shale and schist fissured rock, without resorting to blasting.

2.2.4 **Hard Rock:** This category includes excavation in hard rock requiring hand or mechanical chiseling or blasting. In case of difference in opinion between the classification of rock requiring blasting and that requiring chiseling, wedging, the site of work shall be inspected by the engineer and the decision of the Engineer shall be final and binding on the Contractor.

2.3 LIMITATION OF EXCAVATION

2.3.1 The trench for laying DI pipes shall have minimum width as per standards stipulated or as directed by the Engineer-in-charge. A minimum earth cover of 1.0 m shall be maintained above the pipe top, unless otherwise specified or shown in the alignment drawings.

2.3.2 The Contractor shall be responsible to ensure that the widths and depths of the trenches do not exceed the limits shown in the construction drawings. Should the excavation occur beyond the dimensions specified therein, because of the negligence of the Contractor, the Contractor shall fill the excess space with granular material or concrete as directed by the Engineer. Nothing extra shall be paid to the Contractor on account of this.

2.4 TRIAL PITS

2.4.1 Trial pits may be dug by the Contractor, without being directed to do so, along the alignment as shown on the drawings in advance of the excavations for the purpose of satisfying himself as to the location of underground obstructions or soil conditions, type of existing materials, dia. Of pipeline etc., complete.

2.5 SLIPS AND SLIDES

2.5.1 The Contractor is responsible for proper protection of excavations made by him from any slips and slides. All slides and caving shall be handled, removed or corrected by the Contractor without any extra compensation at whatever time and under whatever circumstances they may occur. The excavations shall be made good and brought to necessary depth, width and levels without any extra cost.

2.6 STOCKING OF EXCAVATED MATERIALS

2.6.1 The excavated material shall be stacked on the sides of the trench wherever possible. Wherever it is not possible to stock on the sides of the trench, contractor has to find the place nearby for stocking the excavated material and cart the materials to & fro. Rate for this shall be included in the earthwork itself and no extra rate will be paid for this.

2.6.2 Surplus earth is to be disposed off to a place identified by the contractor approved by the engineer. There is a item for this work and will be paid accordingly.

2.7 Safety measures

The Contractor shall provide adequate safety measures during excavation. They shall include:

1. Barricading all sides of the open trenches.
2. Red danger lights which can be easily visible from dusk to dawn placed at an interval of 20 m.
3. Traffic signals and display boards giving direction for diversion of traffic at the appropriate places as may be directed by the Engineer.
4. Adequate safe wooden plank / board or steel plate over the trenches to facilitate crossing by the public residing on either side of the trench.
5. Round the clock watch and ward maintaining all safety regulations at the site of work and protecting the site from unauthorized intrusions.

2.8 Progress of Excavation of pipe trenches

The Contractor shall adjust excavation of trenches in such lengths that the pipes can be laid in such exposed portion of the trench within 2 days.

2.9 Shoring and Bracing

The Contractor shall supply, fix and maintain necessary sheathing, shoring and bracing etc., in steel or wood, as may be required to support the sides of the excavation, to protect workmen in the trench and to prevent any trench movement which might any way injure or delay the work, change the required width of the trench, make unsafe condition for adjacent pavements, utilities, buildings or other structures above or below ground.

Sheathing, shoring and bracing shall be withdrawn and removed as the backfilling is being done, except when the Engineer may agree that such sheathing, shoring and bracing be left in place, at the Contractor's request. In any case, the Contractor shall cut off any such sheathing at least 600 mm below the surface and shall remove the cut off material from the trench.

All sheathing, shoring and bracing which are left in place under the foregoing provisions shall be removed in a manner so as to not endanger the completed work or other structures, utilities or property, whether public or private.

2.10 EXCAVATION

2.10.1 Excavation in Rock

Excavation in rock shall be carried out to a depth, 150 mm more than the bottom level of pipe and to a width equal to the diameter of the pipe plus minimum working space on either side as given in drawing. Unless otherwise directed by the Engineer, rock excavation shall be progressed at least by 50 m in advance of the pipe length proposed to be laid.

2.10.2 Excavation for Valve Chambers and Other Appurtenant Structures

The Contractor shall excavate as required for all structures with foundations to firm, undisturbed earth up to the level of the underside of the structure. If the excavation is in rock, the Contractor shall excavate all rock at least to the minimum limits shown on the standard details for trenches and to the grade of the bottom of inlets, junction chambers or other structures as required. Where the bottom of the structure is in rock, it should be ensured that no rock shall project above the lower surface of the concrete in such a manner so as to reduce the required thickness of concrete placed simultaneously as an integral part of the foundation and to the outside of structure foundation where structure is to be built. The Contractor shall excavate the trench / pit to provide necessary working space on all sides and for accommodating any sheathing, shoring or bracing etc.

2.11 Contractor's Responsibility

The Contractor shall be responsible for the adequate pumping, drainage and bailing out water from the excavated trench. In case of failure to make such provisions or any other provisions which may result in unsuitable sub-grade conditions, the Contractor shall replace and repair the sub-grade as directed to the satisfaction of the Engineer, at his own cost and responsibility.

Should the Contractor select to use a gravel sub-grade to facilitate flow of water to pumps or other points of disposal, such gravel sub-grade shall not be measured or paid for as an extra item.

2.12 Works Included in Excavation

The following works as per specifications are also included in excavation and the term 'Excavation' shall construe to mean all such items of work. The quoted rates should include the same:

1. Provision of side space or additional space in the trench/pit for working and/or accommodating sheathing, shoring, bracing, etc.
2. Supply, installation and removal after the work, all sheathing, shoring and bracing required to protect the excavation where required or where such work is recommended by the Engineer.
3. Protection of excavations.
4. Providing adequate safety measures.
5. Additional work in connection with overhead wires and poles.
6. Excavation for Socket hallows.
7. Supplying and fixing of sight rails and boning rods in the trench to facilitate measurement of work.

2.13 Measurement and Payment for Excavation

2.13.1 For Excavation

The measurement for excavation shall be considering the allowable widths, depths with allowed side slopes (if any) for different classes of soils as per approved classification. The measurement for excavation shall be based on "neat line" dimensions as specified in the drawing or Specifications, for different types of soils and depth of excavation. The quantity shall be measured in cubic meters correct to two decimal places. The method of measurement for excavation in different classes of soils shall be as follows:

2.13.2 In Ordinary Soil and Soil Mixed with Disintegrated Rock and Soft Rock / Shale

In this category of soils, the excavation quantity shall be computed as specified above.

2.13.3 In Hard rock

In case of hard rock requiring chipping or chiseling, measurements shall be taken prior to and after chiseling and the volume of rock excavation shall be measured based on this difference. The excavation in rock shall be paid on stack measurements with a deduction of 40% in volume for voids.

2.13.4 For Excavation in Combination of Ordinary Soil, Disintegrated Rock, Soft Rock/Shale and Hard Rock/Schist

Wherever the excavation is undertaken in combination of ordinary soil, disintegrated rock, soft rock /shale and hard rock, the hard rock part shall be measured and paid, the soil part shall be measured and paid for the total measurable excavated quantity deducting the quantity measured for the hard rock. The total computed volume of excavation shall be equal to the sum of the computed volumes for each category of excavation undertaken.

2.14 Protection of Utilities

The Contractor is required to carefully examine the location of the Works and their alignments and to make special enquiries with all authorities concerning all utility lines such as water, sewers, gas pipe, telephone (underground and/or overhead) lines, electric cable (underground and/or overhead) lines, etc.; and to determine and verify to his own satisfaction the character, sizes, position and lengths of such utilities from authentic records. The Contractor shall be wholly responsible for the protection and/or facilitating relocation of such utilities as may be required, and shall not make any claim for extra work or extra time that may be required to protect or facilitate relocating such utilities. If any major shifting or realignment of water, sewers, gas pipes, electric and telephone lines is necessary due to their interference with the proposed Works, the same may be done by the Employer. The cost of such relocation will be borne by the Employer.

In case the alignment of the pipeline crosses high tension electrical transmission lines belonging to the Karnataka Power Transmission Corporation Ltd. (KPTCL) or other authorities, the Contractor shall take all precautions necessary to see that the work is carried out with care and safety, without disturbing such transmission lines. The Contractor will be responsible to carry out all construction activities in such reaches in consultation with the owners of such facilities. However, satisfactory completion of the entire work will be the responsibility of the Contractor.

III. BEDDING.

3.1. Bedding for the pipe

Bedding shall be provided all along the stretch of the pipe line, which differs based on the area through which the pipe line passes. However, the type of bedding to be provided shall be as decided by the Engineer.

3.2 Earth Bedding

The pipes shall be placed on the natural, undisturbed earth bedding, which has been carefully shaped to fit the lower part of the pipe for a width of at least 50 % of its external diameter. The trench shall be

excavated to an extra breadth and depth, wherever weld joints are coming. Filling and removing earth or similar materials beneath the pipe to adjust with the grade will not be permitted except filling with compacted granular bedding material or murrum.

3.3 Gravel Bedding

Wherever rock is met with, it shall be removed up to 150 mm below the bottom level of the pipe to a minimum width equal to the width of the trench and the resulting space shall be filled up with good quality compacted gravel. The granular material shall be filled in the trench up to the level of ¼ the outer diameter of the pipe line, above the bottom of trench and well compacted. Unless otherwise directed by the Engineer, rock excavation shall progress at least 20 m in advance of the pipe length proposed to be laid.

3.4 Measurement for bedding:

The Contractor shall include the cost of earth bedding required for the pipeline in the tendered rate for pipe laying, for providing gravel bedding. The surplus quantity of excavated earth shall be disposed off. The quantity shall be measured in cubic meter correct to two decimal points.

IV BACK FILLING

4.1 General

The Contractor shall use selected surplus spoils from excavated materials for backfilling. All fill material shall be subject to Engineer's approval. The excavated materials suitable for backfilling shall be stored not closer than 600 mm from the edge of the trench and shall not obstruct any public utilities or interfere with travel by local inhabitants or general public. Handling and storage of excavated materials must meet with the regulations of the Local Government Authorities. The detailed specifications for backfilling shall be as per Clause 8 of IS: 3114-1994 and Clause 4.11 of IS 12288-1987.

4.2 Method of Backfilling

Trenches and excavated pits for structures shall be backfilled to original ground level or to such other levels, as the Engineer may direct. All backfilling shall be carried out in orderly manner expeditiously and consistent with good workmanship.

4.2.1 Backfill material put into the trenches/pits for backfilling, shall unless otherwise specified be compacted and built up as to minimise future settlement as much as is reasonably possible. For this, care shall be exercised in selecting backfill material free from large hard clay lumps, especially in cramped areas directly adjoining the walls of structures.

4.2.2 Backfilling in trenches shall be done as pipe laying progresses, with the permission of the Engineer, after the pipe or conduit is properly bedded, jointed and inspected and all measurements for the location of Y-Junctions, tees, etc., are properly recorded by the Engineer and sufficient time is allowed for the joint materials or cement concrete or

mortar to set. However, the joints shall be left open for inspection during testing, which shall be backfilled after successful completion of testing, after obtaining permission from the Engineer. Backfilling around and over the pipe, conduit, or structure shall be taken up uniformly on all sides and in the sequence and manner specified hereinafter, with care to avoid the displacement or damage to the pipe, conduit or structure. For the purpose of backfilling, the depth of trench shall be divided into the following three zones measured from bottom to top of trench, as follows:

i. Zone A : From bottom of trench to the centre line of pipe,
ii. Zone B : From the level of centre line of pipe to a level of 300 mm above the top of pipe,
iii. Zone C : From a level of 300 mm above the top of pipe to the top of trench.

4.2.3 Backfilling in the trenches and around structures shall be carried out in horizontal layers of uniform thickness of not more than 150 mm when measured loose. As may be necessary to attain maximum compaction, the backfill material shall be moistened by sprinkling with water. After placing each layer of backfill material, the layer shall be thoroughly and uniformly compacted by means of mechanical or hand tampers. The compacting equipment and the manner of its use shall be subject to the approval of the Engineer.

4.2.4 After the backfill material is placed in Zone A and Zone B as specified above, the remaining portion i.e., Zone C of the trench may be machine backfilled. Even in this case the backfill material shall be placed in uniform horizontal layers of not more than 150 mm thickness. Small pebbles of size less than 50 mm, if any, shall be so distributed throughout the mass, that all interstices are solidly filled with fine material. The backfill material shall be tamped with mechanical tamping equipment, after moistening the backfill by sprinkling with water to obtain maximum compaction (min 95% proctor density).

4.2.5 Machine backfill shall be so conducted that the material deposited in the trench shall not fall directly on top of the pipe from such a height as might result in damage to the pipe joints or alignment.

4.2.6 If the trench is subjected to conditions which might cause flotation of the pipe before sufficient backfill has been placed, the Contractor shall take the necessary precautions to prevent floatation of the pipe, conduit or structure.

4.2.7 Before final acceptance of the work, additional tamped earth shall be added to restore the settled trench surface to the required level of the adjacent earth surface or to the base of crushed rock wearing surface or to the finished earth base.

4.2.8 If from the excavated soil, enough backfill material is not available, imported, selected and approved backfill material from the borrow pits is required to be placed for backfill, on approval of the Engineer backfilling of trenches where the excavation is in the rock shall be with the surplus soft soil, with all lead and lift.

4.3 Disposal of Surplus Excavated Material

The excavated material which is in surplus to the requirements after backfilling shall be removed and spread at places shown by the Engineer, with all lead and lift from the site of work, for which payment shall be made as per the quoted rates. No surplus or excess material shall be disposed in a stream / channel or in any place where the pre-construction surface drainage may have to be provided, without written permission of the Engineer.

V DUCTILE IRON PIPELINE

5.1 Scope

This specification covers the requirements for manufacturing, supplying, laying, jointing, testing and commissioning of Ductile Iron pipeline and fittings including associated civil works required for the same.

5.2 Standards

The following specifications, standards, and codes are part of this specification. All standards, specifications and codes of practice referred herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern,

IS:8329 Centrifugally Cast (Spun) ductile Iron Pressure pipes for water, gas and sewage.

IS:638 Sheet rubber jointing and rubber insertion jointing.

IS:1387 General requirements for supply of metallurgical materials**.**

IS:1500 Methods for Brinell Hardness test for metallic materials.

IS:9523 Ductile Iron fittings for pressure pipes for water, gas and sewage.

IS:12820 Dimensional requirements of rubber gaskets for mechanical joints and push on joints for use with cast iron pipes and fittings for carrying water, gas and sewage.

ISO:4179 Ductile iron pipes for pressure and non-pressure – Centrifugal cement mortar lining – General requirements.

ISO:2531 Ductile iron pipes, fittings and accessories for pressure pipe lines.

IS:5382 Specification for Rubber Sealing rings for Gas mains, water mains and sewers.

AWWA C600 Installation of ductile iron water mains and their appuratenances.

IS:11906 Recommendations for cement-mortor lining for cast iron, mild steel and ductile iron pipes and fittings for transportation of water.

IS:3764 Excavation work – code of safety.

IS:12288 Code of practice for use & laying of Ductile iron pipes.

IS:460 Test sieves – Part I

IS:8112 Specification for 43 Grade Ordinary Portland Cement.

BS 3416 Bitumen based coatings for cold application, suitable for use in contact with potable water.

BS EN 545 Ductile iron pipes, fittings, accessories and their joints for water pipelines – requirements and test methods.

ISO 81790 For zinc coating.

5.3. Manufacture of pipe

DI pipes and fittings (Class K7 & K9) shall be in accordance with IS: 8329 and IS: 9523. Pipes and fittings shall be procured from reputed manufacturers with Engineer's approval. Engineer shall at all reasonable times have free access to the place where the Pipes and fittings are manufactured for the purpose of examining and testing the pipes and fittings and for witnessing the test and manufacturing.

All tests specified either in this specification or in the relevant Indian Standards specified above shall be performed by the Manufacturer / Contractor at his own cost and in presence of Engineer if desired. For this, sufficient notice before testing of the pipes and fittings shall be given to Engineer.

If the test is found unsatisfactory, Engineer may reject any or all pipes and fittings of that lot. The decision of Engineer in this matter shall be final and binding on the Contractor and not subject to any arbitration or appeal.

The pipes and fittings shall be stripped, with all precautions necessary to avoid warping or shrinking defects. The pipes and fittings shall be free from defects. Any defect in pipes and fittings in the opinion of Engineer shall be rejected and shall be replaced by new one.

In the case of spigot and socket pipes and fittings, the socket shall be without the centre ring.

In the case of flanged pipes, the flanges shall be at the right angles to the axis of the pipe and machined on face. The bolt holes shall be drilled and located symmetrically off the centre line. The bolt hole circle shall be concentric with the bore and bolt holes equally spaced. The flanges shall be integrally cast with the pipes and fittings and the two flanges of the pipe shall be correctly aligned.

a). Materials

The materials used in the manufacture of pipes and fittings shall comply with requirements specified in IS: 8329 - 2000 and IS: 9523 - 2000.

b). Dimensions and Tolerances

The internal diameter, thickness and length of barrel, dimensions of pipes and fittings shall be as per relevant tables of IS: 8329/IS: 9523 for different class of pipes and fittings. Pipe of standard length of 6m is recommended and other properties for pipes and fittings shall be as per IS: 8329/IS: 9523. Each pipe shall be of uniform thickness throughout its length.

The tolerances for pipes and fittings regarding dimensions, mass, ovality and deviations from straight line in case of pipes shall be as per IS: 8329/IS: 9523.

5.4 Testing

(a) **Mechanical tests**

Mechanical tests shall be carried out during manufacture of pipes and fittings as specified in IS: 8329/IS: 9523. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 8329. The tests results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS: 8329/IS: 9523.

(b) Brinell Hardness Test

For checking the Brinell hardness, the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS 1500. The test shall comply with the requirements specified in IS 1500/IS 8329.

(c) **Retests**

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the tests results satisfy the specified requirements, the lot shall be accepted. Should either of these additional test pieces fail to pass the test, the lot shall be liable for rejection.

(d) Hydrostatic Test

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in IS 8329/IS9523 for a period of minimum 15 seconds, during which the pipes shall be struck moderately with a 700 g hammer for conformation of satisfactory sound. They shall with stand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.
During manufacture, tests on pipes shall be carried out in accordance with **clause 1.2.8 of this Technical specification** by the Third party inspecting agency.

5.5 Jointing of pipes

(a) General

Jointing of DI pipes and fittings shall be done as per IS: 12288 and manufacturer's recommendations. After jointing, extraneous material, if any,

shall be removed from the inside of the pipe. Rubber sealing rings/gaskets used for jointing shall conform to IS: 638, IS: 12820 and IS: 5382.

(b) Spigot and Socket joints

These shall have sockets, which are integral with the pipe and incorporate an electrometric rubber ring gasket conforming to IS: 12820.

The gaskets/sealant used for joints shall be suitable for water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipment to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that the rubber ring as per IS: 12820 and IS: 5382 is correctly positioned in line, before the joint is made. The rubber rings and any recommended lubricant shall be obtained only through the approved supplier and as directed by the Engineer.

(c) Gaskets for Flanges

All gaskets used between flanges of pipes shall be of natural rubber conforming to IS: 638 of thickness 3 mm suitable for waste water conveyance and as specified by manufacturer.

(d) Flanged joints

These shall be of PN 1.0 rating and shall comply with dimensions and drilling details as specified in IS: 8329. These shall have isolation gaskets between the flanges, isolation sleeves around all bolts and isolation washers under all bolt heads and nuts. All material shall be supplied by a reputed manufacturer and shall be approved by the Engineer.
Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The recommended bolting torque to be followed for assembling flanges shall be as specified in manufacturer's instructions. The practice of fully tightening the bolts one after another is highly undesirable. The bolts shall be of mild steel unless otherwise specified. They shall be coated with coal tar epoxy coating after tightening.

5.6 Specials

Standard DI fitting shall be in accordance with IS:9523. Wherever standard DI specials are not available, they shall be manufactured and tested as per requirements with the approval of Engineer.

5.7 Coatings

i). General

Unless otherwise specified, DI pipes and fittings shall be coated with Bitumen in accordance with relevant IS specifications. All buried DI pipes and fittings shall also have factory or site applied polythene sleeving. Coating shall not be applied to pipe and fittings unless its surface is clean, dry and free from rust. Pipe coatings shall be inspected at site and any damage or defective areas shall be made good to the satisfaction of the Engineer.

ii). Bitumen coating

Bitumen coating shall be of normal thickness of 75 microns unless otherwise specified. It shall be cold applied compound complying with the requirements of relevant Indian standards, suitable for tropical climates, factory applied in accordance with the manufacturer's instructions.
Damaged areas of coating shall be repainted on site after removing any remaining loose coating and wire brushing any rusted areas of pipe.

iii). Cement mortar lining

All pipes and fittings shall be internally lined with cement mortar in accordance with relevant IS. The cement used shall be Sulphate Resisting Cement confirming to IS: 12330. No admixtures in the mortar shall be used without the approval of the Engineer. The curing shall commence immediately after completion of the mortar lining, shall not be later than 8 hours after mixing of mortar. The lining shall be kept continuously in moist condition for a period of minimum 14 days.

Pipe linings shall be inspected on site and any damage or defective areas shall be made good to the satisfaction of the Engineer.

Lining shall be uniform in thickness all along the pipe. The minimum thickness of factory applied cement mortar lining shall be as per IS: 11906.

5.8. Marking

Marking shall be done as per IS: 8329 and IS: 9523 or any other relevant IS codes approved by the Engineer. The following information shall be clearly marked on each pipe,

a). Internal diameter of pipe.
b). Class of pipe.
c). Date of manufacture and
d). Name of manufacture or his registered trade-mark or both.

cations.

5.9. Trenching.

Trenching includes all excavation which shall be carried out either by hand or by machine and shall be carried out in accordance with all requirements of part-2 Earth work excavations clause 2.0 to 2.17.wherever a socket or collar of pipe or fitting / special occurs, a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand all-round the socket in order to make the joint, and the grip shall be maintained clear, until the joint has been approved by Engineer.
Wherever D.I. pipes are laid over pillar supports for nala crossings etc. the pipes shall be placed as per the construction drawings and as directed by the Engineer In-charge.

The width of the trench shall be kept to a minimum consistent with the working space required and having regard to the safety of the trench, the method of laying and jointing the pipe and the need to avoid damage to pipe coating and so as to provide the minimum horizontal clearance as stated in

the table below. The bottom of the trench shall be properly trimmed to permit even bedding of the pipeline.

The portion of the trench which extends from the formation level to not less than 300 mm above the crown of the pipe when laid in its correct position, shall, unless otherwise specified or ordered by the Engineer, be formed with vertical sides. The clearance between the sides and bottom of the trench and the barrel of the pipe shall not exceed the following, inclusive of any allowances required for temporary trench supports:

Pipe Nominal Bore (mm)	Bottom Clearance (mm)	Side Clearance (mm)
350 to 600	200	300
> 600 to 800	200	350

The clearance at joints may be increased to allow the joints to be made and inspected, any proposed increase shall be approved by the Engineer.

All trenches deeper than 1.2 m shall have the trench walls battered or supported to ensure the safety of all persons working in the trench if required. The Contractor is to provide details of these arrangements for approval by the Engineer prior to any work being undertaken in such a trench.

No excavations with battered sides shall be made in roads, footpaths, private gardens, or within 10m of any buildings or other structures.

The Contractor shall erect temporary fencing around all open excavations and post warning signs in English and the local language. All fencing shall be at least 1 m tall, rigid in nature and strong enough to prevent people falling into the trench. The Contractor shall also take all other necessary measures to ensure the safety of the public and others.

The maximum length of excavation which may be left open in any length is 500 m or as directed by Engineer. The opening of two lengths within 500 m of each other shall require the approval of the Engineer.

The excavation shall be kept free of water to allow: placing of bedding, laying of pipes. inspection and testing of joints, coating of joints, placing of backfill and other activities within the pipe trench, to be carried out in a satisfactory manner.

The excavation shall be done such that it does not get far ahead of laying operations. Before excavating trench the alignment of pipeline shall be approved by Engineer. Cuttings length and other appurtenances shall be provided to suit detailed pipe configurations required.

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs. red lanterns and guards as required shall be placed and maintained during the progress of the construction work and until it is safe for the traffic to use the roadways. The relevant Indian standards and the rules and regulations of local authorities in regards to safety provisions shall be observed.

The road metal and also the rubble packing shall first be stripped off for the whole width of the trench/pit and separately deposited in such place or places as may be determined by Contractor and approved by Engineer.

During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit, or as may be necessary to prevent the sides of the trench pit to slip or fall, or at such a distance and in such a manner as to avoid covering fire hydrants. sluice valves, manholes cover etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organisations or otherwise as Engineer may direct.

Contractor shall take into account additional excavation if any as Engineer may require in order to locate the position of water pipes, drains, sewers etc. or any other works which may be met with, in or about the excavation of trenches while quoting the rates for excavation of trenches while quoting e rates for excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as Engineer ma direct, and shall be protected by the Contractor from damage during the progress of the work. Any damage to the service lines shall be borne by Contractor. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipe line of water, gas, sewage etc.

5.10 Grade of concrete

5.10.1 Ordinary Concrete

In case of ordinary concrete, mix is not required to be designed by preliminary tests and proportions of cement, fine aggregates and coarse aggregates are specified by volume. The ordinary concrete shall be in four grades designated as M 7.5, M 10, M 15 and M 20. It can also be specified by volumetric mix as given in Table-4 below. For cement which normally comes in bags and is used by weight, volume shall be worked out taking 50 kg of cement as 0.035 cubic meters in volume. Shaking, ramming or hammering shall not be done. Proportioning of sand shall be as per its dry volume and in case it is damp, allowance for 'bulkage' shall be made as per IS: 2386 (Part III).

Ingredients required for ordinary concrete containing one bag of cement for different proportions of mix shall be as given in Table-4 below.

Table-4

Ingredients Required for Ordinary Concrete

Grade of Concrete *	**Nominal Mix by volume Cement: Fine Aggregate: Coarse Aggregate****	**Total quantity of dry in kg (max) by mass per 50 kg of cement (to be taken as the individual masses of fine and coarse aggregates)**	**Quantity of water in liters (max) per 50 kg of cement*****
M 7.5	1:4:8	625	45

M 10	1:3:6	480	34
M 15	1:2:4	350	32
M 20	1:1.5:3	250	30

* In the designation of a concrete mix, letter 'M' refers to the mix and the number refers to the specified 28 days' works compressive strength of that mix on 150 mm cubes, expressed in N/ sq. mm.

** The proportions of the aggregate shall be adjusted from upper limit to lower limit progressively as the grading of the fine aggregates becomes finer and the maximum size of coarse aggregate becomes larger.

*** The amount of water should be kept minimum required for proper workability. The quantity given in the column is not to be exceeded.

5.10.2 Strength Requirement of Concrete

Where Ordinary Portland Cement conforming to IS.269 or Portland Blast Furnace Cement conforming to IS:455 is used, the compressive strength requirements for various grades of concrete controlled as well as ordinary shall be as given in Table-5. Where rapid hardening Portland cement is used, the 28 days compressive strength requirements specified in Table-5 shall be met at 7 days.

For controlled concrete, the mix shall be so designed as to attain in preliminary tests a strength at least 33 per cent higher than that required on work tests for concrete up to and including M 25, and 25 per cent higher for higher grades. Preliminary tests need not be made in case of 'ordinary concrete'.

Table-5

Strength Requirements

Grade of Concrete	**Compressive test Strength on 150 mm cubes after testing in accordance with IS: 516 (N/sq.mm)**		
	Minimum Cement Content	**Minimum at 7 days**	**Minimum at 28 days**
M 15	300	10	15
M 20	320	13.5	20
M 25	340	17	25
M 30	360	20	30

In all cases, the 28 days compressive strength specified in Table-5 shall alone be the criterion for acceptance or rejection of the concrete.

Where the strength of a concrete mix, as indicated by tests, lies in between the strength for any two grades specified in Table-5, such concrete shall be classified for all purposes as a concrete belonging to the lower of the two grades between which its strength lies.

5.10.3 Use of Plums in Ordinary Concrete

Stone Plums shall not be used unless specified in the drawings. When stone plums are used, the size may be from 150 to 300 mm. The maximum dimension of these stones or plums shall not exceed 1/3rd the least dimension of the members.

All plums shall be hard, durable, clean and free from soft materials or loose pieces or deleterious substances in them and shall not have sharp corners.

During concreting the first layer of concrete of the specified mix shall be laid to a thickness of at least two and a half times the thickness of the maximum size of plums to be used. The plums shall then be laid while the top portion of this concrete is still green but sufficiently stiff to prevent complete submergence of the plums under their own weight. These plums shall be about half embedded in the concrete and the remaining part exposed so as to form a key with the next layer of concrete. No plums shall be used for concrete-laid under water.

While placing the plums, care shall be taken to see that the clear distance between any two plums is not less than either the width or thickness of either of the plums. The distance from plums to the outer surface or from any steel reinforcement shall be equal to greatest width of the plum.

If plums of stratified stone are used, they shall be laid on their natural bed. Stones with concave faces shall be laid with the concave portion upwards. The thickness of the next and successive layers of concrete shall be at least twice that of the largest plums. The total volume of plums shall not exceed 15% of the volume of the finished concrete.

5.11. Laying of pipes and fittings.

Pipes and fittings shall be laid in accordance with IS 12288 and manufacturer’s instructions.

The pipeline shall be constructed in lengths with a separate full-time gang working on each length. The work on lengths may proceed concurrently. The programme for pipe laying shall be submitted to and be approved by the Engineer at the start of the Contract. Any subsequent changes to the programme shall be submitted to and approved by the Engineer before work to a different programme is started. Excavation for the pipeline in anyone length shall not at any time proceed more than 2 km beyond the end of a hydraulically tested, completed and backfilled length of pipe, unless otherwise approved by the Engineer. The exposed joints between tested sections shall be disregarded in the above definition.

No metal tools or heavy objects shall be permitted to come into contact with the pipes or fittings. External coated pipe shall be handled at all times with wide non-abrasive canvas, rubber or leather straps or other equipment to prevent damage to the coating. The use of chains, wire slings, or any other handling equipment found to be injurious to the coating shall not be permitted. The timber or skids used to support the coated pipe prior to lowering into the trench shall be properly padded with sufficient bags stuffed with sand or straw for the purpose of protecting the coating. Alternatively, the pipe may be supported alongside the trench on mounds of sand. Any injury to the protective coating from any cause must be repaired before the pipes or fittings placed in the trench. During laying operations, no debris, tools cloth or other material shall be placed in the pipe. Pipes and fittings shall be lowered into the trench with equipment suitable for the weight of the pipes and fittings, and they shall be carefully cleaned before jointing.

Pipes shall be laid accurately to the lines and levels shown on the Drawings, within a tolerance of ± 10mm.

Pipe alignments shall be straight between bends or curves. Length laid to curves shall only be allowed where shown on Drawings or in accordance with detailed proposals approved by the Engineer.

Properly painted sight rails shall be supplied and erected, with boning rods of predetermined measurement for the boning of individual pipes to the correct gradient. The sight rails shall be situated vertically above the line of the pipe or immediately adjacent thereto, and there shall at no time be less than three sight rails in position on each length of pipeline under construction to anyone gradient.

The Contractor may submit to the Engineer for his approval an alternative method of the control of pipe laying to the correct levels and alignment.

The joining of pipes shall be made in accordance with the requirements of this Specification. The Contractor shall obtain from manufacturers all special information regarding the handling of the pipes, joints and other fittings and he will be deemed to have made himself thoroughly conversant with all phases of pipe laying before commencing' the' works.

A "badger" or "bung" about 10mm smaller than the internal diameter of the pipe shall be kept in the pipe at all times, pulled forward as the work progresses. When pipe laying is not in progress, including overnight, the open ends of the pipeline shall be blanked off with a temporary watertight fitting approved by the Engineer. The pipe shall be suitably held down so that the pipe does not become buoyant in the event of the trench becoming flooded.

To restrict the flow of rain runoff along the trench the Contractor shall plug the trench with backfill material at distances not exceeding 250 m until the pipeline can be filled in. The plugs shall be removed when trench filling is taking place. In granular bedding areas the plugs shall be of clay and shall be left in.

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure/pipeline of water, gas , sewage etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Engineer. Pipes and fittings/specials shall be carefully lowered in the trenches. Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings shall be made by Contractor. In no case pipes and fittings shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings/specials shall be used to lift and lower the coated pipes and fittings/specials. The pipes and fittings/specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. If doubt persists, further confirmation shall be done by pouring a little kerosene/dye on the inside of the pipe at the suspected spot. No sign of kerosene/dye should appear on the outside surface. Pipes and fittings damaged during lowering or aligning shall be rejected by Engineer and shall be replaced by new one.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipeline runs uphill in which case the socket ends should face the upgrade. The laying of pipes shall always proceed upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings/specials of proper dimensions to ensure such uniform space. Precautions shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer. During the period that the plug is on, the Contractor shall take proper precautions against floating of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted the deflection allowed at joints shall not exceed 2° for 600 mm and 800 mm, 3° for 300 mm, 350 and 450 mm diameter pipes.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner by using tools and taking precautions as per manufacturers' recommendations without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe: cutting machine shall be used.

The valve chamber frame and cover (Cast Iron and Fibre reinforced concrete) shall be as specified in Part 24. clause 24.3.11.

5.12 Thrust / Anchor Blocks.

Anchor blocks shall be provided at horizontal bends. vertical bends or/and at intervals on pipelines with gradients in excess of 1 in 6 as noted on the Drawings, and at other locations ordered by the Engineer. The anchorages shall be made from concrete and constructed to the dimensions shown on the Drawings. Where faces of anchor blocks are shown to bear against undisturbed ground, the Contractor shall take all necessary measures to ensure that such bearing is given over the full dimensions shown.

5.13 Backfilling

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline as directed by Engineer. Backfilling shall be in accordance with requirements specified hereafter and as shown on Drawings.

On completion of the pipe laying operations in any section, for a length of about 100 m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of trench excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the Contractor is not complying with

any of the foregoing requirements, he may prohibit further trench excavation until he IS satisfied with the progress of laying and testing of pipes and refilling of trenches. Filling to a level of 300 mm above the crown of the pipe shall be done in accordance with the requirements of the clause on bedding. Care shall be taken during backfilling, not to injure or disturb the pipes,' joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline shall not be permitted unless the trench has been filled with the instructed bedding and surround material up to height of at least 300 mm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench shall be filled in with selected excavated material free from and topsoil, vegetation or boulders and clods of earth larger than 75 mm in size. Filling shall be done in layers not exceeding 150 mm in thickness accompanied by adequate watering, ramming etc., so as to be compacted to 95% of the maximum dry density as per Part 7 of 18:2720. The water contents of the soil shall be kept as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place. The surface of the refilled excavations shall be left slightly higher than the adjacent ground and be maintained by the Contractor to a smooth even slope.

The Engineer shall, at all times. have powers to decide which portion of the excavated materials shall be used for filling and in which portion of the site and in what manner it shall be so used.

If suitable material for refilling is not available from already excavated material the Contractor shall import material of approved quality as directed by the Engineer. Unless expressly specified in the Bill of Quantities. the Contractor shall include the above under backfilling rates.

Regular measurement of the field dry density shall be taken by the Contractor at various levels in the backfilling as required by the Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval from the Engi neer has been obtained.

Should any subsidence take place either in the filling of the trenches or near about it during the works the Contractor shall make good the same at his own cost.

Surplus excavated material shall be used to fill in any low spots above the pipeline which are identified on the Drawings or are instructed by the Engineer. Such material shall be evenly placed and compacted in layers not exceeding 200 mm thick after compaction. The method of compaction employed shall achieve not less than 90% maximum dry density as determined from IS 2720: Part 7. Unless approved of by the Engineer, the width of areas to be filled shall not exceed 20m.

5.14 Pipelines under existing roads.

The Contractor shall programme the Works to reduce disruption to road traffic to a minimum, and before any work commences in existing roads shall:

(a) Obtain the full permission and approval of all authorities concerned serving notices of intent to start work as may be necessary and observing all the local Laws and Regulations

(i) Submit details of his proposals, and obtain approval from the Engineer and local highway authority

(ii) Constructing of temporary diversion roads

The pipelines crossing roads shall be encased in M15 concrete as shown on the drawings.

Pipelines which are laid along a road shall be laid in trench. The bed and surround shall be previously specified but above this the trench shall be backfilled with crushed rock up to the underside of the road sub-base. Not more than 20 % of the crushed rock shall pass through a IS test sieve with 4.75 mm apertures and all material shall pass through a IS test sieve having an aperture of 40 mm. The backfill shall be compacted in layers having a maximum thickness of 200 mm and the method of compaction used shall achieve not less than 95 % maximum dry density as determined from IS 2720: Part 7.

5.15 Cleaning of Pipes and fittings.

Pipelines shall be cleaned of all dirt, debris. dust or other deposits before hydraulic test to the satisfaction of Engineer. Cleaning with metal cleaning solution, acid, wire brushes, scrappers or sand paper shall not be permitted.

The section of the pipeline once cleaned shall not be entered into for any purpose later. Sufficient precaution shall be taken to prevent the ingress of any dirt, debris, or dust inside the section. Failing this the section shall be cleaned again at the discretion of the Engineer. When deemed necessary by the Engineer suitable closures shall be provided at the open end or the ends of the cleaned sections

In the case of above ground pipeline, the length of the section to be taken up for cleaning shall be decided in consultation with the Engineer from the point of view of ventilation etc.

In case of buried pipeline a section shall be taken up for cleaning after the work of back filling around and over the pipeline is completed and the spiders have been removed from inside with approval of Engineer.

Pipelines shall be cleaned through a foam swab. Swabbing shall be carried out successively between adjacent swabbing points. The foam swab shall comply with the following:

Pipeline over DN 300 - Swab dia = Pipe dia + 75mm

Quality of swab shall be hard - when restrictions in the main do not reduce the diameter of the pipeline to less than two thirds of the swab diameter

Quality of swab shall be soft - when restrictions in the main are in excess of the above but do not reduce the diameter of the pipeline to less than one half of the swab diameter.

The Contractor shall make necessary arrangements for equipment, fittings and water necessary for cleaning the pipeline. The Contractor shall submit proposals for swabbing, water storage and disposal arrangements to the Engineer for approval.

No separate payment will be made for the work of cleaning and providing closures. The rates quoted for the laying of pipes shall include the cost of cleaning also.

5.16 Erection - General

The Contractor's staff shall include adequate and competent erection engineers with proven, suitable, previous experience on similar contracts to supervise the erection of the Works and sufficient skilled, semi-skilled and unskilled labour to ensure completion of Works in time. The Contractor shall not remove any representative, erector or skilled labour from the Site without prior approval of the Engineer's Representative.

The Contractor shall ensure that no installation or erection work shall commence until full and unconditionally approved working drawings, signed and stamped by the Engineer are available at Site.

The Contractor's erection staff shall arrive on the Site on dates to be agreed by the Engineer. Before they proceed to the Site, however, the Contractor shall first satisfy himself, as necessary, that sufficient plant of his (or his sub-contractor's) supply has arrived on Site so that there will be no delay on this account.

One erection engineer per pumping station who shall be required to be the Contractor's representative shall be conversant with the erection and commissioning of the complete Works. Should there be more than one erector, one shall be in charge and the Contractor shall inform the Engineer's Representative in writing which erector is designated as his representative and is in charge. Erection engineer is to report to Project Manager.

The Contractor shall be responsible for setting up and erecting the plant to the line and levels of reference and of the positions, levels dimensions and alignment, appliances and labour in connection therewith. The checking of setting out of any line or level by the Engineer or Engineer's Representative shall not in any way relieve the Contractor of his responsibility for the correctness thereof.

Erection of Plant shall be phased in such a manner so as not to obstruct the work being done by other contractors or operating staff who may be present at the time. Before commencing any erection

work, the Contractor shall check the dimension of structures where the various items of Plants are to be installed and shall bring any deviations from the required position, lines or dimensions to the notice of the Engineer. Plant shall be erected in a neat and workmanlike manner on the foundations and at the locations shown on the approved drawings. Unless otherwise directed by the Engineer, the Contractor shall adhere strictly to the aforesaid approved drawings. If any damage is caused by the Contractor during the course of erection to new or existing Plant or buildings or any part thereof, the Contractor shall, at no additional cost to the Employer, make good, repair or replace the damage, promptly and effectively as directed by the Engineer and to the Engineer's satisfaction.

The Contractor shall align all equipment and holding down bolts and shall inform the Employer before proceeding with grouting-in the items concerned. The Contractor shall ensure that all equipment is securely held and remains in correct alignment before, during and after grouting-in.

The approval by the Employer of the Contractor's proposals for rigging and hoisting any items of the Plant into final positions shall not relieve the Contractor from his responsibility for damage to completed structures, parts or members thereof or other installed equipment.

He shall at his own cost make good, repair or replace any damaged or injured items, whether structural, electrical, architectural, or of any other description, promptly and effectively to the satisfaction of the Employer.

No plants or other loads shall be moved across the floors of structures without first covering the floors with timber of sufficient size so that applied loads will be transferred to floor beams and girders of steel or concrete. If it is required to reduce bending stresses and deflection, the beams and girders shall be provided with temporary supports. Any movement of Plant and other loads over the floor structures shall be subjected to the prior approval of the Employer.

During erection of the Plant the Engineer will inspect the installation from time to time in the presence of the Contractor's Site representative to establish conformity with the requirements of the Specification. Any deviations and deficiencies found or evidence of unsatisfactory workmanship shall by corrected as instructed by the Engineer.

5.17 Levelling and Grouting of Machinery

Contractor shall check the civil works, where the Plant is to be installed sufficiently in advance, for their conformity to the approved drawings for installing the Plant with respect to lines, levels and accuracies of positions embedments, anchorage pockets, cutouts etc. He shall record all measurements and deviations in prescribed control formats. He shall proceed with the works, with the Engineer's consent to such preparatory inspection of works.

Contractor shall mark precisely the centrelines and datum reference on the civil works, where the Plant is to be installed with reference to bench marks, using indelible means of marking.

He shall undertake sufficiently in advance chipping of any unevenness of concrete on foundations, anchor bolt pockets, cutouts etc., to achieve uniform level of reference for erection. All concrete surfaces receiving grout shall be hacked as required to ensure better bonding with grouting.

Contractor shall undertake the inspection of all components to be erected sufficiently in advance to check their soundness and conformity to drawings and the inspection records shall be signed by the Engineer as approval for undertaking the installation of the components. Any damage, shortfalls etc. shall be made good to the satisfaction of the Engineer.
All grout for equipment shall be carried out using non-shrinkable continuous grout materials with suitable frame work of at least 12 mm thickness. Surfaces to receive the grout shall be hacked and roughened and laitance shall be removed by wire brushing or blast of air. Concrete surface shall be blown off by compressed air before commencing grouting.

Grouting shall be done in one continuous operation from one side such that grout flows in a single wave until grout reaches all confined spaces with no air pockets and air form all confined spaces is expelled. A hydro static head of 150 mm shall be maintained during grouting operations. All grouting shall be carried out in the presence of the Engineer's Representative. All lines and levels shall be checked up after grout is set. Block outs shall be closed using cement concrete of the same grade as that of the parent structure.

5.18. Records, Procedures and Reports

The Contractor shall maintain records pertaining to the quality of installation/erection work and inspection, testing, compliance with all technical requirements in respect of all his works as described in the previous paragraphs. The reporting formats shall be in the approved formats. The Contractor shall submit such records to the Engineer after the completion of any particular work before submitting the bill of supply/progress of work. Such report shall comprise shop

inspection reports, shop testing reports, material test reports, based on which despatch clearances are provided, all the quality control reports of welding, erection and alignment records.

All the above mentioned records shall be submitted in the final form duly countersigned by the Engineer's Representative attesting conformity to specifications and his approval of installation, and duly incorporating all the additions, alternations, and information as required by the Engineer, on the basis of preliminary reports giving the progress of the work. Such records notwithstanding, any records submitted earlier with bill of supply/progress etc., shall be duly bound and submitted to the Engineer in six copies by the Contractor on his notification of the mechanical completion of erection.

5.19 Hydraulic Testing

Structures, Pipelines and fittings shall be subjected to hydraulic pressure tests in the presence of the Engineer which shall comply as per applicable IS unless otherwise specified.

Testing shall be carried out in two stages;

(i) Test of sections as construction proceeds

(ii) A test of the whole of the pipeline on completion

The Contractor shall equip himself with all plant, equipment, fittings and water necessary for the hydraulic tests. The Contractor shall submit to the Engineer, well in advance of the time of tests, details of his proposals, including the supply of water either by tankers or boreholes. No connections from the existing pipelines will be allowed, nor will any connections to the pipeline and pipe work which would involve cutting, tapping or altering the Permanent Works be allowed.

Test gauges shall be of approved manufacture having dials at least 200 mm diameter. graduated such that the test pressure is at least 75 % of the full-scale reading shall be used, If necessary different gauges shall be supplied for different pipeline sections. Two gauges shall be provided for the sole use of the Engineer and shall remain in Engineer's possession for the duration of the Contract. All gauges shall be dead weight tested and calibrated at the commencement of work and at regular intervals as required by the Engineer.

The Contractor's arrangements for testing shall include a suitable means of quick installation and removal of the Engineer's gauges during testing.

5.20. Test pressures

Test pressures are to be measured in bars at the centre of the blank flange situated at the lowest end of the pipeline under test. Unless otherwise specified or shown on the drawings pipeline test pressure shall be in accordance with the following:

DI /MS pipe and fittings without HSC 10 bar

DI /MS Pipes and fitting with HSC 05 bar

For testing of sections of pipeline containing air valve chambers the Contractor shall verify from manufacturer that the air valves are capable of operating under and sustaining the test pressure.

5.21 Chamber Markings

Details like valve type. size, cistern number shall be painted on all valve chambers as directed by Engineer. Where valve chambers are flush with the ground, suitable marker posts shall be provided adjacent to the chambers at a suitable location with all details approved by Engineer.

In case of the pipeline laid above ground details such as chainage, invert levels of pipe, saddle number, culvert number, anchor/thrust block number etc., shall be suitably painted either on the pipeline or the supporting structure in distinct colour.

5.22 Measurement and Payment

The measurement for pipes for items specified in Bill of Quantities shall be on running metres of net length along the centre line of the pipe excluding the length of specials and appurtenances. Payment for pipes shall be made in running metres after production of test certificates specified and directed by Engineer.

Payment for laying the pipes and specials shall be made after successful testing at site.

5.23 Location and Protection of Existing Public and Private Utilities.

Once permission to work has been obtained from the road authorities, and prior to excavation, the Contractor shall contact all utility companies and householders in roads where work is to take place and inform them of the nature of the work and its likely duration. Information should be obtained from utilities companies about the location of their utilities, preferably in the form of record drawings, and the Contractor should carry out utilities tracing using electronic equipment to verify the positions of utilities. Trial excavations should also be carried by hand to further confirm locations of utilities. The Engineer will only permit trench excavation to proceed when he is satisfied that adequate efforts have been made to establish the alignments and depths of existing utilities.

All underground utilities such as water pipes, gas pipes, drains, sewers, electricity and telephone cables exposed in excavations, shall be properly supported and protected by the Contractor to the satisfaction of the Engineer so as to avoid damage to the utility or to the Works as a result of collapse of the utility. Similarly, poles carrying overhead electricity and telephone wires should be braced and supported where there is any likelihood of collapse as a result of excavation.

5.24 Valves-Deleted- Given in subsequent sections.

VI. ANCILLARY STRUCTURES

6.1 The Contractor shall build Valve Chambers & Thrust Blocks/Anchor blocks and such other miscellaneous structures that may be required at the locations shown by the Engineer and as shown in the drawings or as may be otherwise specified or directed. unless otherwise specified in this Chapter or advised by the Engineer based on the site conditions.

The various structures shall be built as the pipe laying progresses and the Engineer at his discretion, may stop work entirely on the laying of pipe or construction of other structures, until the construction of the structures already approved by the Engineer are completed by the Contractor.

6.2 Thrust Blocks

Thrust blocks shall be provided for both horizontal and vertical bends as suggested, for effective transfer the hydrostatic thrust developed during the operation of the rising main. They shall be constructed at the locations shown in the alignment drawings, and are of the respective dimensions shown therein. The surrounding virgin land of the thrust blocks shall not be disturbed, to effectively transfer the thrust developed in the main.

6.3 Valve Chambers

RCC valve chambers shall be provided for all valves. These valve chambers are of different sizes suitable for air valves, scour valves & Control valves with RCC pre-cast slabs covering.

6.4 Structures for Crossing Canal/ Nallahs and Other Miscellaneous Structures

Structures for crossing the pipeline over canals/Nallahs and other miscellaneous structures not listed in these specifications but may be required to be built shall be as per construction drawings and as described in Bill of quantities. The materials of construction of workmanship for those structures shall conform to the relevant Standard Specifications. The measurement of quantities involved in these structures for payment shall be done as per dimensions of the respective drawings.

MILD STEEL PIPELINE

6.1 Scope

This specification covers the general requirements for fabrication, laying, testing and commissioning of longitudinal & circumferential welded mild steel SAW pipes above /below ground, including associated civil works required for the same.

6.2 Standards

The following specifications, standards, and codes are part of this specification. All standards, specifications and codes of practice referred herein shall be the latest edition including all applicable official amendments and revisions.

In case of discrepancy between this specification and those referred to herein, this specification shall govern,

IS 2062	Steel for general structural purposes
IS 808	Dimensions for hot rolled steel beam, column channel and angle sections
IS 814	Covered Electrodes for manual metal arc welding for carbon and carbon manganese steel
BS 5155	Specifications for butterfly valves
AWSS-5.1	Specification for mild steel covered arc welding electrodes
IS 3613	Acceptance tests for wire flux combination for submerged arc welding
AWS: A-5.17	Specification for Bare Mild Steel Electrodes and Fluxes for submerged arc welding
IS1367	Technical supply conditions for threaded steel fasteners.
IS2016	Plain washers
IS2074	Ready mixed paint, air dying, red oxide zinc chrome. Priming
IS1786	High yield strength deformed steel bars and wires for concrete reinforcement
IS432 (Part-1)	Mild steel & Medium Tensile bars and hard drawn steel wire for concrete reinforcement: Part 1 Mild steel and medium tensile steel bars
IS432 (Part 2)	Mild steel and Medium tensile steel bars and hard drawn steel wire for concrete reinforcement: Part 2 Hard drawn steel wire
IS 269	33 grade ordinary Portland cement
IS8112	Specification for 43 grade Ordinary Portland Cement
IS8041	Specification for Rapid hardening Portland cement
IS383	Specification for coarse and fine aggregate from natural source
IS12330	Specification for Sulphate Resisting Portland cement
IS 4353	Submerged arc welding of mild steel and low alloy steels recommendations
IS456	Code for practice for plain and reinforced concrete
IS800	Code of practice for general construction in steel
IS816	Code of practice for use of Metal arc Welding for General construction

IS817	Code of practice for Training and Testing of Metal Arc Welders
IS1182	Recommended practice for Radiographic examination of Fusion Welded Butt joints in steel plates
IS2595	Code of Practice for Radiographic Testing
IS3658	Code of practice for Liquid Penetrant Flew Detection
IS5334	Code of practice for Magnetic Particle Flaw Detection of welds
ASTM E 94	Recommended Practice for Radiographic Testing
ASTM E 109	Dry powder Magnetic Particle Inspection
ASTM E 138	Wet magnetic Particle Inspection
ASTM E 165	Liquid Penetrant Inspection
IS 3600	Methods of testing of Fusion Welded joints and Weld metal in steel
IS 483	Recommended practice for Radiographic inspection of fusion welded butt joints in steel pipes
IS 3589	Specification for seamless or Electrically welded pipes for water, Gas and Sewage
IS 6631	Steel pipes for Hydraulic purposes
IS 7343	Code of practice for ultrasonic testing for ferrous Welded Pipes and Tubular Products
IS 2598	Safety code for Industrial Radiographic Practice
IS 5822	Code of Practice for laying of electrically welded steel pipes for water supply
IS 1566	Hard drawn steel wire fabric for concrete reinforcement
IS 6419	Welding rods and bare electrodes for glass shielded are welding of structural steel
IS 1974	Bare wire electrodes for submerged arc welding
IS 7307	Approval tests for welding procedures
IS 7310	Approval tests for welders working to approved welding procedures
IS 2720	Methods of test for soils
IS 780	Specification for Sluice valves for water work purposes. (50 to 300mm size)
IS 2906	Specification for sluice valves for water work purposes (350 to 1200mm size)
IS 1916	Steel cylinder pipe with concrete lining and coating

IS 7322	Specials for steel cylinder reinforced concrete pipes
IS 11906	Recommended for cement mortar lining for cast iron, mild steel and ductile iron pipes and fittings for transportation of water.

6.3 Materials

Steel plates – The steel plates for pipes fittings, specials and stiffeners shall be of mild steel conforming to IS2062 Grade B, with no negative tolerances on the plate thickness

Cement – Ordinary Portland cement conforming to IS 269.

Aggregate – The aggregate shall confirm to IS 383

Water – The water used in preparation of concrete mix shall conform to the requirements of mixing water specified in IS : 456

Welding consumables – such as electrodes, filler rods and wires shall conform to IS 814, IS 3613, IS 6419 and IS 7280

When requested by the Engineers, the contractor shall provide test sample of the materials to be used in the works for testing. The cost of such tests shall be borne by the contractor and shall be included in his item rates.

6.4 Inspection

All works and material under specification will be rigidly inspected during all phases of manufacture and testing and such inspection shall not relieve the contractor of his responsibility to furnish materials and performed work in accordance with this specification.

The contractor will notify the engineer, in advance of the procurement of materials and fabrication thereof, in order that the employer may arrange for mill and shop inspection. The engineer may reject any or all materials or work that does not meet with any of the requirements of this specification. The contractor shall rectify or replace such rejected material/performed work at his own cost, to the satisfaction of the engineer.

The Engineer shall have free access to those parts of all plants or any other premises and sites that are concerned with the furnishing of materials or the performance of the work under this specification.

The contractor shall supply free of cost required specimen of materials for testing by the employer at any time during the progress of work and shall bear the cost of all such tests or retests to the satisfaction of engineer.

The contractor shall provide 2(two) sets of accurate “GO” and ‘No Go’ ring gauges to measure the diameter of pipes, specials and fitting for the use of the Engineer at no extra cost.

6.4.1 Some of manufactures of MS pipe are detailed below:

1)	**M.S. PIPES**

1.	M/s. Steel Authority of India Ltd., No.8, BISL Building, J.C. Road, Bangalore-560 002.
2.	M/s. Welspun, Trade World, 'B' Wing, 9th Floor, Kamala Mills Compound, Senapati Bepat Marg, Lower Parel, Mumbai- 400 013,
3.	M/s. Swastik Pipes Ltd., No.41, K.M. Delhi, Rohtak Road, District Jhajjar (Haryana).
4.	M/s. Asian Mills Pvt.Ltd., 104, Sarkar-III Opp. Old High Court, Near Income Tax Circle, Ahmedabad-380 014.
5.	M/s. Surya Engineers, Plot No. G20/8, MIDC Area, Ahmadnagar, Maharashtra.
6.	M/s. PSL Holdings, 22, Vaijavoor Village, Malai Vaiyavoor P.O., Mahuranthakam Taluk, Kancheepuram Dist – 603 308.
7.	M/s. Maharashtra Seamless Ltd., Pipenagar, Village Subeli, N.H.17, B.K.G. Road, Taluk Rona, District Raigad, Maharashtra – 402 126.
8.	M/s. Mukut Tanks & Vessels, Surindra House, Safaid Pool, M.V. Road, Sakinaka, Mumbai-400 072.
9.	M/s. Taher Ali Industries & Projects (P) Ltd., Survey No.23/A, Agapally Village, Ibrahimpatnam, Sagar Road, R.R. District, Andhra Pradesh.
10.	M/s. Surindra Engineering Co.,Ltd., Surindra House, P.O.Box 8939, Mumbai.
11.	M/s. Pratibha Pipes & Structural Pvt., Ltd., Shrikant Chamber, Phase II, 5th Floor, Near R.K. Studio, Sion-Trombay Road, Chembur, Mumbai-71.
12.	M/s. Mukat Pipes Ltd., D-46, M.I.D.C., Baramathi, Pune-413 133.
13.	M/s. Subash Pipes Ltd., 279-280, Mysore Bannur Road, Ranganathpura Village, P.O. Rangasamudra District, Mysore.

(Any other reputed make as may be approved by BWSSB at a later date by producing the credentials.) QAP to be submitted for the approval by the employer.

6.5 Manufactures of Pipes and Specials

6.5.1 General

The pipes shall be truly cylindrical, and straight in axis. The ends shall be accurately cut and prepared for field welding the external circumference of the pipe pieces which are to be fixed adjacent to the flange adapter with fixed outer diameter shall not deviate from theoretical one by more than 2mm. to obtain this accuracy the pipe shall be rolled several times, if necessary, as pipe pieces should be truly cylindrical. The external longitudinal welding of this pipe shall be ground smooth flush with surface to the satisfaction of the Engineer, for a length of 200 mm from the ends of the pipe. No extra cost shall be charged by the contractor for this grinding work.

Minor repair by welding or otherwise shall be permitted at the discretion of the engineer, but such repairs shall be done only after obtaining the prior permission from the Engineer. Any pipe or part thereof which develops injurious defects during welding or other operations shall be rejected.

6.5.2 Fabrication Yard

This fabrication yard meant for fabrication of pipes, specials etc shall also be equipped with facilities for testing, guniting, painting etc. For completing the work under the present contract within the contract period, the fabrication yard shall be equipped with adequate numbers of equipment and plant including:

- Plate bending machine for rolling of pipe drums
- Automatic welding machines (suitable for circumferential as well as longitudinal welding)
- Hydraulic welding machines
- Traveling gantry or crane of capacity 10 tonnes or above
- Mobile cranes for loading/unloading of plates, pipes etc. 15 tonnes capacity each
- Lathe for machining of the flange rings, plates etc.
- Equipment for sand blasting, cement mortar lining, and facilities for bitumen wrapping

The fabrication yard shall have adequate area, and shall also have stacking areas for the stacking of plates, pipes and fittings. The contractor shall make his own arrangements for any area required.

6.5.3 Demonstration

Contractor shall demonstrate the works in this contract at fabrication yard before commencement of works and during the works at intervals specified and as directed by the Engineer. No payment shall be made in this regard.

The works under demonstration shall include but not limited to the following:

- Manufacture of pipe and specials
- Machine and manual welding to qualify ‘Welding Procedures’
- Hydraulic testing
- Pipe handling procedures

6.5.4 Cutting plates to size

The plate provided shall be utilized so as to minimize wastage and so as to make the pipe as far as possible with one longitudinal joint. Plate sizes shall generally suitable for fabrication of 1.5 m long shells (minimum), to be made up to pipes of 6.0 m to 12 m lengths to suit contractor’s proposed working methods.

Before cutting, all the edges of the plates shall be cleaned by brushing/grinding both the sides.

After the plates are cut, the edges shall be made smooth and even by polishing with an electrical or pneumatic grinder to remove all inequalities. Care shall be taken to see that the cut edges of the plate are perfectly

straight. Jigs to be used for this purpose shall depend upon the types of cutting machine used. The plates cut to the required shapes shall be checked for the correctness before they are rolled into pipe drums. If any correction is required, the contractor shall do the same by re-cutting, if necessary. If any plate or flat is found to be warped, to have corrugations, the defects shall be removed by putting the plate or flat into a roller press and rectified. Laminated or heavily corroded plate shall not be used in manufacturing of the pipe.

The ends of the finished pipe in the factory shall necessarily have bevel ends conforming to IS 3589 to facilitate field welded joints.

6.5.5 Rolling of Plates

The plates cut to the exact size shall be put into a rolling machine to form a pipe of the required diameter. The contractor shall adjust the rolling machine so as to give a uniform curvature to the pipe throughout its circumference. The curvature obtained shall be checked by the contractor's foremen during the process of rolling and if proper curvature is not obtained at any place including the ends, the rolling operation shall be repeated at this stage or even after the longitudinal welding of the drum where directed. Heating of plates to obtain the desired curvatures shall not be permitted.

6.5.6 Tracking the Drums

The rolled drums shall be kept on an assembly platform for tracking, care being taken to ensure that the tacked drums have either faces at right angles to the axis of the pipe. A gap of 2 mm to 4 mm shall be maintained while tacking the drum, where the manual arc welding, is permitted. However, where the welding is to be done by automatic welding machine, there is no need to maintain such gap. To achieve this objective, clamp spiders, tightening rings and or any other approved gadgets shall be used. Each drum, before being taken to the assembly platform, shall be numbered on the inside with oil paint, stating the plate thickness as well.

6.5.7 Assembly of Drums into Pipes

The tacked drums shall then be transported to an assembly platform where they shall be welded together to form suitable pipe-lengths. Plate shall be bent in the maximum possible width to reduce the number of circumferential joints. The number of longitudinal joints shall be as per IS 3589.

The longitudinal joints shall be staggered at 90 degrees. The drums shall be tacked together as above. The assembly shall be truly cylindrical and without any kinks. The faces shall be at right angles to the axis of the cylinder. A suitable arrangement for testing the correctness of the pipe shall be provided by the contractor at the assembly platform.

6.5.8 Specials

Specials shall be fabricated to the dimensions shown on drawings. Specials, such as tees, Y-pieces, bends, tapers, etc. shall necessarily be in steel and shall be in accordance with IS 7322/BS 534/AWWA C208 and ASME standards and tested and laid in the same manner as the pipes.

Standard fittings shall be used wherever possible in preference to fabricated fittings. Standard fittings shall be manufactured in accordance with

standards above. Where fabricated fittings are supplied with approval of Engineers they shall be fully workshop fabricated and tested in accordance with above standards.

Tee and branches on steel pipelines must be reinforced by welding collars around the base of the branch and in the case of large diameter branches, increasing the main pipe wall thickness or making use of crotch plates. Unless shown otherwise on the drawings branches shall comply with the requirement of the following table:

Fitting Description Pipe work O.D. (mm)	Main Pipe wall Thickness (mm)	Branch Pipe Wall Thickness (mm)	Collar Details (mm)
324 off 1999	14/12	5.0	150 Wide x 14 to 25 Thick
324 off 1999-1549 Taper	14/12	5.0	150 Wide x 14 to 25 Thick
324 off 1999-Level Invert Tee	14/12	5.0	150 Wide x 14 to 25 Thick
324 off 1647	11/12	5.0	150 Wide x 14 to 25 Thick
324 off 1241	8/10	5.0	150 Wide x 14 to 25 Thick

The fittings shall be designed and, if considered necessary by the Engineer, fabricated by a specialist contractor and the design calculations and drawings shall be submitted to the Engineer for approval. For oval shaped collars the width given in the above table shall be at the narrowest point. All other fittings, tees, branches, crosses and bends are to be designed by the fabricator.

Steel specials shall have the same chemical and mechanical properties and shall be compatible in all respects with the pipes with which they are to be used. The marking of pipes and fittings shall be as specified.

6.5.9 Electrodes

The contractors shall use appropriate type and size of electrodes with suitable flux covering depending on the thickness of plate and the type of joint. They shall also use standard current and voltage required for the machine in use as per manufacturer's directions. Welding electrodes shall conform to IS 814 and IS 4353. electrodes from reputed manufacturers like Advani Oerlikon, D& H, Philips etc. shall be used with the approval of Engineer. India made or equivalent foreign made electrodes of the approved quality shall be used. The contractor shall provide suitable equipment and ovens to keep the electrodes dry at the desired baking temperature.

6.5.10 Welding

Upon receipt of the order and prior to the start of fabrication, the contractor shall submit to the Engineer for his approval the 'Welding Procedure Method Statement' he intends to use in the shop work. At the same time the

procedure for the field welding must be submitted to the Engineer for his approval.

All components of pipe shell, either straight or bent etc shall be welded by use of automatic arc welding machine by submerged arc process with alternating current. The strength of the joint shall be at least equal to that of the parent material. Manual welding shall be adopted only when machine welding is not possible.

The contractor shall use electrodes of approved make and size, the size depending on the thickness of the plate and the type of joint. Standard current and arc voltage required for the machine shall be used with necessary modifications as may be found necessary after experimental welding. For this purpose, samples of welded joints shall be prepared and tested in the presence of the Engineer for qualifying the welded procedure Method statement. Only approved welding procedures of the Engineer shall be obtained.

All the shop and the field welding conform to IS 4353, IS 9595, IS 816.

All longitudinal and circumferential joints shall be Single-V or Double-V butt joints with or without backing plates. After completing the welding joints of pipes or plates from one side, and before the welding on the other side, the joints shall be back chipped/ gouged and ground to remove irregular penetration till the even surface is exposed. Gouging shall be restored to when the plate thickness is above 6mm.

All circumference welds involving plates of unequal thickness shall be so kept that the inside surface of plates match to provide stream lined joints without alteration in the internal diameter.

The welding shall be the best workmanship free from weld defects. In order to maintain a good standard in welding, welders shall be tested by the contractor before they are entrusted with the job. Qualification standard for welding procedures, welders and welding operators shall confirm IS 7307 and IS : 7310 (latest). Only those who pass the test shall be allowed to work on the job. Periodical tests as regards their competence shall also be taken at suitable intervals and those found incompetent shall be removed from the job. If an incomplete welder has already welded some pipes, all welding done by him previously shall be fully checked by X-ray in addition to the regular X-ray inspections. The defects if any, shall be rectified to the satisfaction of the Engineer. All such check tests and rectification of defects shall be entirely at the cost of the contractor. No pipes or steel sections shall be erected unless the work of the welders concerned has been proved to be satisfactory and qualified. Site welds shall be done by welders qualified for the various welding positions as per applicable IS codes and standards.

A record shall be maintained showing the names of welders and operators who have worked in each individual joint. Manual arc welding shall preferably be carried out by a pair of welders so that by, observing proper sequence, distortion can be avoided. A joint entrusted to a particular individual or a pair shall be as far as possible, completed by them in all respects, including sealing run. No helper or other unauthorized person shall be permitted to do any welding whatsoever.

The weldment should not become brittle or sensitive to blows and there should be no loss of toughness due to welding or heat treatment. The

material after welding and heat treatment shall match with the base metal properties including original ductility. The weld should in no point be less than the nominal thickness of plate a slight reinforcement as per IS code shall be maintained on all weld joints. Final welding of closure gaps should be carried out within a temperature range of average air temperature ± 8° C.

Where required by the Contractors working methods the pipes shall have cable holes /entries installed in the fabrication shop; they shall comprise a hole in the pipe with a reinforcing plate welded to the pipe with a tapped hole in it large enough to allow the passage of the cables and other paraphernalia necessary for welding the pipes. A screwed plug shall be provided to close the hole.

6.5.11 Testing of Weld Coupons

Test pieces shall be provided by the contractors for both longitudinal and circumferential welded and joins at the positions pointed out by the Engineer the sample so taken out shall then be cut to the exact shape and dimensions and machined as described in relevant standards before testing for chemicals and mechanical properties.

The entire cost of the tests including provision of test samples, machining the test pieces, transport to and from the laboratory and testing them in a laboratory, payment of all testing fees, cleaning and painting etc. shall be borne by the contractors. The tests shall be carried out in a government or semi government institute approved by the Engineer. This shall be arranged by the contractor with the approval of Engineer. the testing laboratory shall have instruments/ equipment which are having calibration requirements traceable to National or International standards.

The following tests shall be carried out:

Mechanical Tests

The test plates shall be subjected to all mechanical tests as per the approved method statement, or as otherwise reasonably directed by the Engineer. Test shall be carried out in the accordance with relevant standards. The tests shall include determination of yield strength, tensile strength, elongation and bend tests. Tensile test shall be carried out in accordance with IS 1894. One test plate shall be provided for from each lot of 100 lengths.

If a test specimen shows defective machining or develops flaws not associated with welding, it may be discarded and another specimen submitted. The welded joint shall exhibit mechanical properties not lower than those specified for highest 2062 Grade B.

Guided bend test shall be in accordance with IS 3589/IS 3600. One bend test shall be carried out from each lot of 50 lengths. The test shall comply with the requirements specified in IS 3589/ IS 3600.

Field Joints

The field welded joints shall be tested in accordance with the proce3dure laid down in IS3600. One test plate shall be taken for every 10 joints and shall be subjected to mechanical and chemical tests as specified above.

6.5.12 Re-tests

If the results of tests of any lot do not conform to the requirements specified, retests of two additional specimens from the same lot shall be made,. Each of which conform to the required specifications, in case of failure of one or both, gouging and repairing shall be carried out to the particular lot of joints from which the samples have been taken as directed by Engineer before the lot can be accepted. The rectification process shall also have adequate tests plates and they shall be tested for complaints with the IS codes/standards.

In case both the samples yield satisfactory results in the retest described above, gouging and repairing will be required to the carried out on the joint which has failed in the initial test only.

All charges in connection with retesting of the welded sample including machine, testing etc. shall be borne by the contractor.

6.5.13.

The MS pipeline should be Hydraulically tested at the site for 10bar and commissioned accordingly.

6.5.14 Tolerances

Tolerances of the plate thickness shall be ± 3%. Minimum width of the plate shall be 1.5m.

A tolerance for straight pipes shall be in accordance with IS 3589 or as amended below.

Finished pipe sections shall be truly straight with walls parallel to the axis of the pipe and shall not be out of the alignment by more than 0.2% of the total length.

The outside circumference of the pipe shall not vary by more than 0.5 per cent.

Outside diameter of the pipe shall not vary by more than plus or minus 0.5 per cent.

The permissible tolerance for specials for diameter, arm length and angular deviation shall be in accordance with IS 7322/BS 534.

Whenever any dent, i.e., a significant alteration of the curvature of the pipe shell is noticed, the depth of the dent shall be measured between the lowest point of the dent and the pipe shell curvature line. All dents exceeding 2 per cent of the outer diameter of the pipe shall be removed by cutting out a cylindrical portion of the pipe and replacing the same by an undamaged piece of the pipe. the Engineer may permit insert patching if the diameter of the patch is less than 25 percent of the nominal diameter of the pipe. Repairs by hammering with or without heating shall not be permitted. Any damage to the coating shall also be carefully examined and rectified.

6.5.15 Pipe Testing in Fabrication Yard

A hydraulic test shall be carried out at the fabrication shop for each pipe length fabricated, in the presence of and to the satisfaction of the Engineer. All pipes and specials shall be subjected to hydraulic test at the fabrication yard after fabrication, but before application of protective coatings.

Prior to testing, the pipe shall be inspected thoroughly and all the apparent defects in welding such as slag, prosperity etc. shall be repaired by gouging and re-welding.

Each pipe shall be filled with water slowly and the pressure increased uniformly until the required test pressure is reached. The test pressure shall be 18 bars for pipes and specials with 10mm thick MS plate.

The pipe tested shall be given a serial number which shall be painted with details such as pipe number, shell thickness, diameter, length etc. as directed by Engineer. It shall be entered in the register to be maintained by the contractor. The register shall be maintained in suitable format giving the following information for each shell tested:

- Serial No.
- Pipe No.
- Date of test
- Specification and thickness of steel
- Weight of pipe shell tested
- Maximum test pressure
- Details of test performance
- Details of radiographic examination of welds
- Name of Engineer's representative witnessing tests.
- A copy of these details shall be furnished to the Engineer.

For indicating the pressure inside the pipe an accurate pressure gauge of approved make duly tested and calibrated for the accuracy of readings shall be mounted on one of the closures which close the pipe ends.

The pressure shall be applied gradually by approved means and shall be maintained foe at least 10 minutes or till the inspection of all welded joints is done during which time the pipe shall be hammered throughout its length with sharp blows, by means of a 1 kg hand hammer.

The pipe shall withstand the test without showing any sign of weakness, leakage, oozing or sweating. If any leakage or sweating is observed in the welded joints, the same shall be repaired by gouging and re-welding after dewatering the pipe. The repaired shall be re-tested to conform to the specified pressure.

If any leak or sweating is observed in pipe shell the pipe under test shall be rejected temporarily. The Contractor shall stack such rejected pipes separately in his yard. The Engineer shall inspect the same as shall determine the nature of repairs to be carried thereon and shall then decide as to how and where they shall be used. No payment shall be made of handling or carrying out repairs, but, payment for, fabrication and shop hydraulic testing of the pipe shall be released only after acceptance of the pipe with necessary repairs and subsequent testing etc. are carried out by the Contractor to the satisfaction of the Engineer. The Engineer shall be supplied with two copies of the results of all the tests carried out.

No pipe shall be transported out of the fabrication yard to the site unless they have hydraulically tested except permitted by the Engineer in writing to do so.

6.5.16 Marking

All pipes and specials shall bear the following markings. The marking shall be on the side which will be the inside of the pipe after bending. The marking operation shall be conducted with full size rulers and templates. Only blunt nose punches should be used.

The plates used for fabrication of pipes shall be laid out in such a way that when the shells are completed one set of original identification markings for the material will be plainly visible. In case these markings are unavoidably cut out, they shall be accurately transferred by the contractor to a location where these markings will be visible on the completed work.

After the hydraulic tests on the specials the direction of the flow shall be stamped in a prominent manner.

- Outside Diameter (mm)
- Length of pipe/angle of the bend (m/degrees)
- Plate thickness (mm)
- Approximate of weight of the pipe/special (tons)

6.6 Joints

(i) General

Unless detailed otherwise, all pipes and fittings shall have welded joints as detailed in Drawings. Where shown on the Drawings, flanged joints or collar sleeve joints shall be provided.

(ii) Welded Joints

The use of butt welded joints for joining pipes shall be in accordance with clause 6.6.10 and end preparation shall be in accordance with IS 3589

(iii) Sleeve collar joints

The use of sleeve collars shall generally be limited to the jointing of pipes at tie-ins. The thickness of the external steel sleeve collar shall be not less than that of the pipe itself and the length a minimum of 300 mm. the sleeve shall be joined to the pipe with an internal full depth structural weld and external sealing welds to allow the joint to be gas tested. A gas testing hole shall be made at each end of the sleeve and for the purpose of gas testing joints.

(iv) Flanged Joints

Flanged shall comply with IS 7322/BS4504. The nominal pressure rating shall be at least equal to the highest pressure rating of the pipes of fittings to which they are attached, but with a minimum PN 16. The contractor shall fabricate flanges meeting the requirements of the pipe sizes under this contract or otherwise to suit the abutting valves or other connections, if they are not readily available. Flanges shall be provided with all necessary nuts, bolts, washers and gaskets, as specified herein. The Contractor shall also supply in suitable containers sufficient graphite grease for application to the bolt threads when joints are made.

(v) Slip of Type Couplings

Slip on Type Couplings shall include the following coupling:

- Straight flexible couplings
- Stepped flexible couplings
- Flange adopters

- Dismantling joints

Slip on Type Couplings shall be from the Viking Johnson System manufactured by the Victaulic Company or form approved suppliers whose fittings meet the same Specifications.

The preparation of pipe ends for slip-on Type Couplings shall be in accordance with the requirements of and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

Slip on Type Couplings shall be protected if buried with Densomastic and Densotape wrapping or similar approved material applied in accordance with the manufacturers recommendations. Flexible joints shall be harnessed or tied where shown on the Drawings. Flexible couplings and flange adaptors shall be supplied with transit protection.

6.7 Storage

Pipes and fittings shall be stored raised off the ground and shall be carefully supported, cushioned and wedged. Special care shall be taken to ensure the steel pipe is cradle and supported in a manner that prevents any distortion of the pipes.

All gaskets, nuts and bolts flange adaptors and other similar items shall be stored in the dry conditions, raised off the ground in sheds or covered areas.

Where items required special storage requirements, the method of storage shall be to the approval of Engineer and in accordance with manufactures requirements.

Storage areas shall be set out to facilitate unloading, loading and checking off materials.

All pipe materials shall be inspected when deposited in the storage area any defects or damage shall be noted and reported to the Engineer. the pipe material shall only be repaired or replace with the Engineers approval.

End covers and other protection shall not be removed until incorporation of the pipes or fitting into the works.

6.8 Transportation and Handling

All pipes and specials fabricated in the yard and temporarily stacked in the factory shall be transported carefully to the site of laying after internal cleaning.

Any vehicles on which pipes are transported shall have a body of such length that the pipes do not overhang. Last pipes shall be placed on cradles and the loads properly secured during transit.

Additional precautions shall be taken to avoid deformation of flexible pipes. To maintain their circular cross-section internal struts shall be fitted in the pipes. Details of the proposed strutting system shall be submitted to the Engineer to the approval and if required by the Engineer, the method of strutting shall be demonstrated and tested on site.

The pipes and specials shall be handled in such a manner as not to distort their circularity or cause any damage to their coating. Wide non-abrasive or other approved slings shall be used and all hooks and other metal devices

shall be well padded. Hooks engaged on the corner wall surface at pipe ends shall not be used. Steadying ropes shall be employed.

The positions of lifting slings shall ensure that stresses and tendency towards deformation in the pipes are kept to a minimum.

Pipe handling equipment shall be maintained in good condition and any equipment, which is in the opinion of the Engineer, may cause damage to the pipes shall be discarded.

Under no circumstances shall pipes be dropped, be allowed to strike one another, be rolled freely or dragged along the ground.

No valves shall be lifted by the spindle.

Fabricated materials such as man-hole covers, appurtenances, bolts, nuts, flanges, saddles, collars, bypass arrangements etc., shall be transported to the site of laying from the fabrication yard according to needs of the laying operations only.

6.9 Pipeline Construction

6.9.1 General

Laying/Erection of fabricated pipe lengths shall be carried out by the Contractor who shall equip himself, at his cost with all necessary tools, machinery, labour etc., required for the purpose. The pipeline shall be constructed in lengths with a separate full time gang working on each length.

Except for routine welding of joints, no other work shall be done in the absence of Engineer.

The components of the sections of the pipeline such as plates, and pedestals have been so designed that the centers of the plates and pedestals shall coincide at the mean temperature of the locality. For this reason, all works such as fixing flanges, plates etc. in true alignment, and in correct position and tack welding pipes shall be done at the mean temperature. For ascertaining the temperature, the contractor shall provide mercury cups and fix them to the pipe shell from outside and shall also provide thermometers of the required type and range. No extra payment shall be made for this.

6.9.2 Laying Program

The contractor shall submit a detailed bar chart for manufacturing and laying of the pipeline, which shall be subject to the Engineer’s approval. In preparing this bar chart, the contractor shall plan his activities such that the laying of pipes shall closely follow the manufacturing schedule and no pipes shall remain in factory or at site for a period more than two months.

Together with the chart he shall submit a methodology describing how he will carry out this work within the contractual period and the required resources in terms of construction equipment and other facilities that he shall utilize to complete the works.

6.9.3 Contractor to Resurvey the Pipeline Route

While setting up the site the contractor shall undertake survey of the pipeline route and compare this with the survey supplied at the time of tender and a

joint record. Levels are to be taken at 30 m intervals and at any sharp changes in level. Where practical the chainage points shall coincide with those original surveys. Not less than 14 days before commencement of pipe laying the Contractor shall supply the Engineer, any discrepancies, if observed, with two hard copies and one computer disk copy of the survey.

The format of the survey shall be identical to the longitudinal sections which formed part of the tender documents. The Engineer shall supply the contractor a copy of the longitudinal section and the contractor is to use this to produce new drawing. Details of all the benchmarks which were used in the original survey of that length of pipeline shall be supplied to the contractor by the Engineer.

The Engineer shall resolve any problem arising from discrepancies between the two surveys and supply the contractor with any revised Drawings that may be required.

6.10 Protective Coating:

After the pipe is subjected to hydrostatic test, 25 mm thick outside coating by gunniting in CM 1:3 over 50 X 50 weld mesh of 13 gauge and inside lining with cement mortar 1:1.5 shall be provided confirming to the specifications given in **IS 3589-2001** with its amendments.

6.10.1 Outside coating:

a. Materials:

i. Reinforcement:

All cage reinforcement used in the pipe shall confirm to IS 432 (Part I of Part II)-1982. Minimum reinforcement in the coating shall be three percent of the quantity of steel cylinder of minimum thickness given in Table 1 of IS 1916-1989. The reinforcement shall be wire mesh electrically welded or woven fabric and specially crimped of otherwise self-furring to held the reinforcement 10 to 13 mm away from the surface on which it is applied. The wire mish shall weigh not less than 12.5 kg/sq.m. The reinforcement shall be free from loose mill scale, dirt or excessive rust. The clear cover to the reinforcement shall not be less than 12 mm for coating.

ii Cement:

Cement used for the inside lining and outside coating shall conform to IS 8112-1976 and as amended from time to time.

iii Aggregates:

Aggregates used for the outside coating and inside lining shall conform to IS 383-1970 and as amended from time to time. The minimum size of aggregate shall not exceed one-third the wall thickness of the pipe or 10 mm whichever is smaller.

iv. Water:

The water used in preparation of concrete mix shall conform to the IS 456.

v. Concrete:

Concrete used for outer coating shall conform to IS 456-2000. The concrete mix shall have a minimum cement content of 450 kg/m^3 and a minimum compressive strength of 21 N/mm^2 at 28 days. Compressive strength tests

shall be conducted on 15 cm cubes in accordance with the relevant requirements of IS 456-2000 and Is 516-1959 and as amended from time to time.

6.10.1.1 Thickness of guniting:

The minimum thickness of guniting Outside minimum 25 mm thick, coating in CM 1:3 over 50 x 50 mm weld mesh of 13 gauge as given below.

6.10.1.2 Preparation of steel surface:

At the time of application of the concrete or mortar, the surface of the pipe shall be clean. Loose rust, loose mill scale, dirt, debris, oil, grease and other detrimental materials shall be removed by manual, mechanical means or by sand or steel grit blasting. The coating shall not commence before the expiry of three days after the completion of the lining unless otherwise it is established that the lining has attained a works cube strength of not less than 10 Mpa earlier than this period. During this entire period the lining shall be under curing. The coating shall be either vibrated or applied under pressure by rotary brushes.

After field welding of the joints, the exposed portions of the adjacent pipes shall be protected by placing wire fabric with tack welds and applying cement mortar by hand.

6.10.1.3 Curing:

After completion of concreting, the concrete or mortar shall be kept wet by any suitable means, such as immersion in water, covering by wet gunny bags, or by mechanical sprinklers, for a period of not less than 7 days. Non pressure steam curing also can be done provided the requirements of non-pressure steam curing are fulfilled.

6.11 Buried Pipelines

6.11.1 Trenching

Trenching includes all excavation which is carried out either by hand or by machine and shall be carried out in accordance with all general requirements of Part-5. In addition to those general requirements, the following requirements shall apply to pipelines:

The width of the trench shall be kept to a minimum consistent with the working space required and having regard to the safety of the trench, the method of laying and jointing the pipe and the need to avoid damage to pipe coating and so as to provide the minimum horizontal clearance as stated in the table below. The bottom of the trench shall be properly trimmed to permit even bedding of the pipeline.

The portion of the trench which extends from the formation level to not less than 300 mm above the crown of the when laid in its correct position, shall unless otherwise specified or ordered by the Engineer, be formed with vertical sides. The clearance between the sides and the bottom of the trench and the barrel of the pipe shall not exceed the following, inclusive of any allowances required for temporary trench supports:

Pipe Nominal Bore (mm)	Bottom Clearance (mm)	Site Clearance (mm)
600 to 1000	250	400

1050 to 2500	300	500

The clearance at joints may be increased to allow the joints to be made and inspected, any proposed increased shall be approved by the Engineer.

All trenches deeper than 1.2m shall have the trench walls battered or supported to ensure the safety of all persons working in the trench of required. The contractor is to provide details of these arrangements for approval by the Engineer prior to any work being undertaken in such a trench.

No excavations with battered sites shall be made in roads, footpaths, private gardens, or within 10m of any buildings or other structures.

The contractor shall erect temporary fencing around all open excavations and post warning science in English and the local languages. All fencing shall be at least 1 m tall, rigid in nature and strong enough to prevent people falling into the trench. The contractor shall also take all other necessary measures to ensure the safety of the public and others.

The maximum length of excavation which may be left open in any length is 500 m. the opening of two lengths within 500 m of each other shall require the approval of the Engineer.

The excavation shall be kept free of water to allow: placing of bedding, laying of pipes, welding of pipes, inspection and testing of joints, coating of joints, placing of backfill and other activities within the pipe trench, to be carried out in a satisfactory manner.

6.11.2 Bedding

The depth and type of bedding shall be as shown in the Drawings or as directed by the Engineer. Where rock or boulders are encountered, the trench shall be transmitted to a depth of at least 300 mm below the level at which the bottom of the barrel of the pipe is to be laid and filled to a like depth with sand as shown on the Drawings or as directed by the Engineer.

The class of bed and surround to be used are indicated below:

Class of bed and surround	Brief description of bedding material
Class N	Well Graded Sand
Class S	Granular material

Class S bed and surround shall be used on all pipes unless otherwise specified or shown on the Drawings.

Class N bed material shall only be used where the pipe trench is founded in hard rock or otherwise directed by the Engineer. the sand shall be clean and well graded and free from topsoil, clay or vegetable matter and to the approval of the Engineer. if the sand supplied is unclean it shall be washed. In no case shall sand containing more than 3.5% by dry volume or 5% by wet volume of clay, loam or silt be accepted. Tests specified for determining silt in sand and organic impurities as described in IS 383 shall apply.

The graded granular bed material for use in Class S bedding and surround shall consist of durable gravel, crushed stone or disintegrated rock. Selected

material excavated from the pipe trench may be used, provided it contains no topsoil, clay or vegetable matter and is to the approval of the Engineer and shall be supplied with the certification which gives details of its content of the granular material shall not exceed 0.5% and 0.06% by weight respectively.

Graded Material.

The Contractor's method of grading the excavated material shall be to the approval of the Engineer. All Class S graded material shall pass through test sieves to IS 460 (Part 1) in the following proportions by mass :

Aperture Size	Percentage passing
50 mm 37.5 mm 20.0 mm 14.0 mm 10.0 mm 5.0 mm	100% 90 - 100% 35 – 70% 25 – 55% 10 – 40% 0 - 5%

6.11.3 Construction of Class S bed and Surrounds

Class S pipe bed and surround shall be constructed as indicated on the Drawings.

The granular material shall be evenly spread over the full width of the formation and lightly compacted to a level slightly higher than level corresponding to the underside of the pipe barrel to allow for settlement of the pipe to the correct level.

Following placement and jointing of the pipe further granular material shall be placed in the trench, special care being taken to fill under the sides of the pipes to ensure full contact with the barrel of the pipe.

Field joints which have not been tested shall be left exposed for a minimum length of 150 mm each side of the joint. The granular material shall then be placed and compacted evenly on both sides of the pipe to a depth of 300 mm above crown of the pipe.

Trench supports shall be withdrawn gradually in accordance with the progress of the fill with the provisions that such withdrawal shall not prejudice the safety of the works.

The contractor shall ensure that the material to the sides of the pipe is adequately compacted in layers having a maximum thickness of 150 mm and that the method of compaction used shall achieve not less than 95 % of the maximum dry density as determined from IS 2720: Part 7

After each section of the pipeline has passed the hydraulic test, the exposed joints shall be backfilled and compacted to the above specification.

The same general requirements shall apply to Class N bedding.

6.11.4 Pipe Laying

Pipe shall be laid in accordance with IS 5822 unless otherwise specified herein.

The pipeline shall be constructed in lengths with a separate full time gang working on each length. The work on lengths may proceed concurrently. The program for pipe laying shall be submitted to and be approved by the Engineer at the start of the contract. Any subsequent changes to the program shall be submitted and approved by the Engineer before work to a different program is started.. excavation for the pipeline in any one length shall not at any time proceed more than 2 km beyond the end of a hydraulically tested, completed and backfilled length of pipe, unless otherwise approved by the Engineer. The exposed joints between tested sections shall be disregarded in the above definition.

No metal tools or heavy objects shall be permitted to come into contact with the pipes or fittings. External coated pipe shall be handled at all times with wide non- abrasive canvas, rubber or leather straps or other equipment to prevent damage to the coating. The use of chains, wire slings, or any other handling equipment found to be injurious to the coating shall not be permitted. The timber or skids used to support the coated pipe prior to lowering into the trench shall not be properly padded with sufficient bags stuffed with sand or straw for protecting the coating. Alternatively, the pipe may be supported alongside the trench on mounds of sand. Any injury to the protective coating from any cause must be repaired before the pipes or fittings placed in the trench. During laying operations, no debris, tools cloth or other material shall be placed in the pipe. Pipes and fittings shall be lowered into the trench with equipment suitable for the weight of the pipes and fittings, and they shall be carefully cleaned before jointing.

Pipe shall be laid accurately to the lines and levels shown on the Drawings, within a tolerance of +- 10 mm.

Pipe alignments shall be straight between bends or curves. Length laid to curves shall only be allowed where shown on Drawings or in accordance with detailed proposals approved by the Engineers.

Properly painted sight rails shall be supplied and erected, with boning rods of predetermined measurement for the boning of individual pipes to the correct gradient. The sight rails shall be situated vertically above the line of the pipe or immediately adjacent thereto, and there shall at no time be less than three sight rails in the position on each length of the pipe under construction to any one gradient.

The contractor may submit to the Engineer for his approval an alternative method of the control of pipe laying to the correct levels and alignment.

The joining of pipes shall be made in accordance with the\e requirements of this specification. The Contractor shall obtain from manufactures all special information regarding the handling of the pipes, joints, and other fittings and he will be deemed to have made him thoroughly conversant with all phases of pipe laying before commencing the works.

A “badger” or “bung” about 10mm smaller than the internal diameter of the pipe shall be kept in the pipe at all times, pulled forward as the work progress. When pipe laying is not in progress, including overnight, the open ends of the pipeline shall be blanked off with a temporary watertight fitting

approved by the Engineer. The pipe shall be suitably held down so that the pipe does not become buoyant in the event of the trench becoming flooded.

To restrict the flow of rain runoff along the trench the contractor shall be plug the trench with backfill material at distances not exceeding 250 m until the pipeline can be filled in. the plugs shall be removed when trench filling is taking place. In granular bedding areas the plugs shall be of clay and shall be left in.

6.11.5 Level Control

The criterion for the level to which transmission main shall be laid such that the cover above the crown of the pipe to ground level shall be as specified in the drawings but in no case shall be less than 1200 mm unless otherwise directed by the Engineer.

6.11.6 Laying to Curves

Where pipes are to be laid to curves, the deflection at each joint shall not exceed one degree. For sharper curves specifically made bends shall be provided.

6.11.7 Lowering and Jointing

The pipe shall be lowered into the trenches such that no part of any shoring is disturbed or damaged and if necessary, additional temporary struts may be fixed during the lowering operations. Care shall be taken to ensure that the longitudinal joints of two consecutive pipes at each circumferential joint are staggered by 90 degree. While assembling the pipes, the ends shall have to be brought close enough to leave a uniform gap not exceeding 4 mm. there shall be no lateral displacement between the pipe faces to be joined. If necessary, spiders from inside and tightening rings from outside or other suitable equipment shall be used to bring the two ends in perfect contact and alignment. In no case shall hammering or longitudinal slitting be permitted. Jacking may be permitted for this purpose in particular circumstances and approval by the Engineer.

When the pipe is properly assembled firmly supported on wooden beams and wedges or by other approved means it shall be checked for correct line and level and tack welded. The tack welded circumferential joints shall then be welded fully.

On completion of the pipe jointing the external portion shall be coated with M15 concrete and the trench and the welding pits shall be cleaned. The welding pit shall be filled with approved bedding.

6.11.8 Floatation

The contractor shall take proper precautions against the risks of floatation and the flooding of the excavated works and shall make due allowances in his program for any closure he considers necessary on account of monsoon.

Should any section of the pipeline be affected by floating in the course of works the entire work shall be removed and then reinstalled to the satisfaction of Engineer. The entire cost of laying it again to the correct line and level shall be to account of the Contractor.

6.11.9 Steel Props

In order to effectively provide cement mortar lining to the inside of the pipes and to avoid difficulties during the work, it is necessary that the roundness of the pipes is maintained circular till the lining work is taken up. To achieve the same, steel adjustable screw type props of screw or similar approved type consisting of minimum six legs(three props) shall be fixed inside the pipe and the diameter correctly set.

The design and drawings of the props that the contractor intends to use should be approved by the Engineer before starting the work. These props shall be fixed vertically at intervals as directed by the Engineer. The props should be kept in position at least for three days after the encasing of the pipe in that section is completed or until refilling is done to the full height of fill over the pipe in case the pipes are not encased. The props shall be removed only after obtaining permission from the Engineer.

6.12 Internal Cement Mortar Lining

All pipes and fittings shall be internally lined with cement mortar in accordance with IS:11906/AWWA C602. Cement mortar in lining shall be applied in-situ after pipe laying and after sectional hydraulic testing.

Cement shall be Portland cement in accordance with IS 8112

Sand used for lining shall be tested with standard sieves as per IS 460 and requirements specified in IS 11906

The minimum cement content shall be 100 kg/m3 and the water : cement ratio by mass shall be between 0.3 and 0.45:1

The mortar shall stop 100 mm back from the faces of any joints. The end face shall be vertical.

6.12.1 Surface Preparation

The interior surface of the pipe to be lined shall be cleaned to remove all rust, chemical or other deposits, oil, grease and all accumulations of water, dirt, and debris. The cleaning of the surface shall be carried out by the use of suitable chemical or mechanical means to the approval of the Engineer. The extent of cleaning shall be to the satisfaction of the Engineer.

All loose mill scale, dirt, rust, and accumulation of construction debris shall be removed from the interior of the steel pipeline. The pipeline shall be cleaned by use of a power-driven cleaner incorporating revolving brushes on rotating arms.

Immediately prior to the travel of the lining machine through the pipeline, all foreign material shall be removed. This includes small sand and loose mortar that might have accumulated since the work of preparation of surfaces was completed.

6.12.2 Mix Proportion

Proportion of sand to cement shall not be more than 1.5 parts sand to 1 part by volume. Mortar composing of cement, sand and water shall be well mixed and of proper consistency to obtain a dense, homogeneous lining that will adhere firmly to the pipe surface. The cement mortar mix shall comply with

strength and density requirements specified in IS 11906/AWWA C602. No admixtures shall be permitted unless approved by the Engineer.

6.12.3 Thickness of Lining

The minimum thickness of lining shall be inside C.M. 1:1.5 lining of minimum 10mm thick up to 610 mm OD & minimum 12mm thick beyond 610 mm OD.

The lining shall be placed by centrifugal method in one course by a machine traveling through the pipe and discharging the mortar at a high velocity over all pipe sections and long radius bends. The discharge shall be from the rear of the machine so that the freshly applied mortar will not be marked. The rate of travel of the machine and the rate of mortar discharge shall be mechanically regulated so as to produce uniform thickness throughout. The mortar must be densely packed and shall adhere to the pipe wherever applied.

6.12.4 Surface Finish

Mortar lining shall be mechanically trowel led except for the places where hand toweling is expressly permitted by the Engineer.

The lining shall be provided with attachments for mechanically trowel ling the mortar. Both the application and toweling of the mortar shall take place at the rear of the machine so that the freshly placed and trowel ling of the mortar will not be damaged. The trowel attachment shall be such that the pressure applied to the pipe will be uniform and produce a lining of uniform thickness with a smooth and even finished surface free of spiral shoulders. The finished surface of machine placed and trowel led linings in pipe shall be examined according to the following procedure.

Thickness of lining shall be ascertained frequently during placing of mortar and trowel ling using an approved non-destructive method.

In the stretch of pipe that has been lined and trowel led in each day’s run, ten places shall be selected in straight sections of the pipe by the Engineer. In each of the ten places the thickness of the lining shall be re measured by non-destructive means as directed by the Engineers.

Defects in lining including but not restricted to sand pockets, voids, over sanded areas, blisters, cracked and dummy areas, and thin spots shall be removed, and the area shall be repaired to the full required thickness of the mortar lining. Defective areas encompassing the full diameter to the pipe shall be replaced by machine. Defective lining rejected at the time of lining shall be removed before initial set of the mortar. Defective lining rejected after initial set shall be replaced or repaired by the most practical method as determined by the Engineer.

Hair cracks or cracks up to 0.25 mm width and not over 300 mm in length in finished linings may be considered acceptable at the discretion of the Engineer but larger cracks shall be repaired or removed and redone all as directed by the Engineer.

6.12.5 Hand application

Cement mortar lining of bends, specials, areas closely adjacent to valves and other such places where machine placing may not be practical shall be

performed by hand. The Engineer may order the correction for any defect by hand application.

Cement mortar for hand work shall be of the same materials as the mortar for machine placed lining.

The areas to be lined shall be thoroughly cleaned as specified earlier and, if necessary, shall be moistened with water immediately prior to placing the hand- applied mortar.

Steel finishing trowels shall be used for the hand application of cement mortar, except at bends the outer edges of hand trowel led areas may be brushed in odder to reduce the abutting offset.

All hand finishing work in a section of the pipeline shall be completed within 24 hours after completion of the machine application of mortar lining that section. If necessary, application of mortar lining by machine shall be delayed or stopped to assure compliance with this schedule.

Hand placed mortar shall have a uniform and smooth surface with smooth transitions to adjacent machine placed linings.

6.12.6 Curing

Curing shall commence immediately after completion of the mortar lining and hand finishing of a section of pipeline. This shall, not be later than 8-hours after mixing of mortar. The lining shall be kept continuously in moist condition for a period of 14 days. During the operation of lining, finishing and curing, exterior surface of the pipe exposed to sunlight shall be sprinkled with enough water to keep the pipe cool. Open ends of pipes shall be suitably closed so as to maintain a moist atmosphere and prevent draught. Curing of mortar lining and simultaneous cooling of the pipeline externally shall be continued even beyond the period of 14 days if so directed by the Engineer.

6.12.7 Tests

Test blocks of the same material as used for the lining shall be made in 150 mm cube moulds and subjected to cube crushing tests. Each block shall be removed from its mould as soon as practicable and cured under the conditions of temperature and humidity identical with those in which the lining of the pipe is cured. The number of tests shall be at least 4 cubes for each age and water cement ratio for each day’s work. The work cube strength of the test cube shall not be less than 300 kg/cm^2 after 28 days of curing or 170 kg/cm^2 of 7 days of curing. The density of the test cube shall not be less than 2300 kg/m^3

6.12.8 Backfilling

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of trench excavation and the contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Engineer considers that the contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and

refilling of trenches. Filling to a level of 300 mm above the crown of the pipe shall be done in accordance with the requirements of the clause on bedding. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. filling shall be carried out simultaneously on both sides of the pipe so that unequal pressure does not occur. walking or working on the completed pipeline shall not be permitted unless the trench has been filled with the instructed bedding and surround material, up to height of at least 300 mm over the top of the pipe except as may be necessary for trapping etc., during backfilling work.

The remaining portion of the trench shall be filled in which selected excavated material free from and topsoil, vegetation or boulders and colds of earth larger than 75 mm in size. Filling shall be done in layers not exceeding 150 mm in thickness accompanied by adequate watering, ramming etc., so as to be compacted to 95 % of the maximum dry density as per Part 7 of IS: 2720. The water contents of the soil shall be kept near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowances for subsequent settlement likely to take place. The surface of the refilled excavation shall be left slightly higher than the adjacent ground and be maintained by the contractor to a smooth even slope.

The Engineer shall, at all times, have powers to decide which portion of the excavated materials shall be used for filling and in which portion of the site and in what manner it shall be used.

If suitable material for refilling is not available from already excavated material the Contract shall import material of approved quality as directed by the Engineer.

Regular measurement of the field dry density shall be taken by the Contractor at various levels in the backfilling as required by the Engineer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval for the Engineer has been obtained.

Should any subsidence take place either in the filling of the trenches or near about it during

The works the Contractor shall make good the same at his own cost.

Surplus excavated material shall be used to fill in any low spots above the pipeline which are identified on the Drawings or are instructed by the Engineer. Such material shall be evenly placed and compacted in layers not exceeding 200mm thick after compaction. The method of compaction employed shell achieve not less than 90% maximum dry density as determine from IS 2720: Part 7. Unless approved of by the Engineer, the width of areas to be filled shall not exceed 20m.

PIPELINE ANCILLARY WORKS

SPECIFICATION
PIPELINE ANCILLARY WORKS

7.0 Service Connections: The House Service Connections shall be made with **Cpvc** pipes and specials manufactured as per IS; 15578/2007.

CPVC MATERIALS

The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade 1, with a Cell Classification of 23447 as defined in ASTM D1784. This compound shall be light grey in colour as specified, and shall be approved by NSF use with potable water.

DIMENSIONS

CPVC Schedule 40 & Schedule 80 pipe shall be manufactured in strict accordance to the requirements of ASTM F441 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM F441. All belled-end pipe shall have tapered sockets to create an interference type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. This pipe shall have a flame spread rating of < 25 and a Smoke Development rating of < 50 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

Sl. No.	Item	Some of the makes preferred.
	CPVC Pipes	Ajay pipes, M/s. Miraj Pipes & Fittings Pvt Ltd, M/s. Prime Pipes & Fittings Pvt Ltd etc.,

(Any other reputed make as may be approved by BWSSB at a later date by producing the credentials.) QAP to be submitted for the approval by the employer.

7.1 Strap/Clamp Saddle

General Specifications:

Strap Saddle for service connection from water distribution mains shall be of wrap around design, wide skirt and wide straps support, which shall reinforce the pipe while providing excellent stability to the saddle.

Saddles for service connections shall be of fastened strap type with threaded

outlet for service connection. The service connection threading sizes shall be conforming to IS: 554
Saddles shall be suitable for DI pipes of nominal size 4” (NB 100) to 12” (NB300) with nominal service connection size from ½” (NB 15), ¾” (NB 20), 1” (NB25), 1 ¼” (NB 32) and 1 ½” (NB 40).

The straps shall be elastomer coated (insulated) type for firm grip on pipe as well as to protect the coating on the pipe and to insulate the un-identical metals. The saddles shall be single strap type up to pipe sizes of NB 300 and service outlet of ½”, ¾” and 1” and double strap type when the service outlet is 1 ¼”, and 1 ½” .

Fasteners shall be of threaded nut-bolt-washer type. Nut-bolts of size ½” (M12) shall be used for saddles of size for 4” (NB 100) and Nut-bolts of size 5/8” (M16) shall be used for saddles of size 6” (NB 150) and above.

The sealing between the saddle and mains shall be obtained by using a profiled elastomer seal matching to the curvature of the pipe. The seal shall be of elastomer type, suitable for all potable water applications.

The Material of construction of the body, straps, fasteners etc. shall be of a non-corrosive material such as engineering plastic (PE/PP) or stainless steel or a combination of both.

The design of the saddle body should be such that, the service connection outlet metal insert shall project out towards pipe side and align with the hole drilled on the pipe to ensure positive locking against rocking or creeping on the pipe, as might be caused by vibration, pressure or excessive external loading.

The clamp saddles shall be suitable for maximum working pressures upto 10 bars.

Material and Design Specifications:

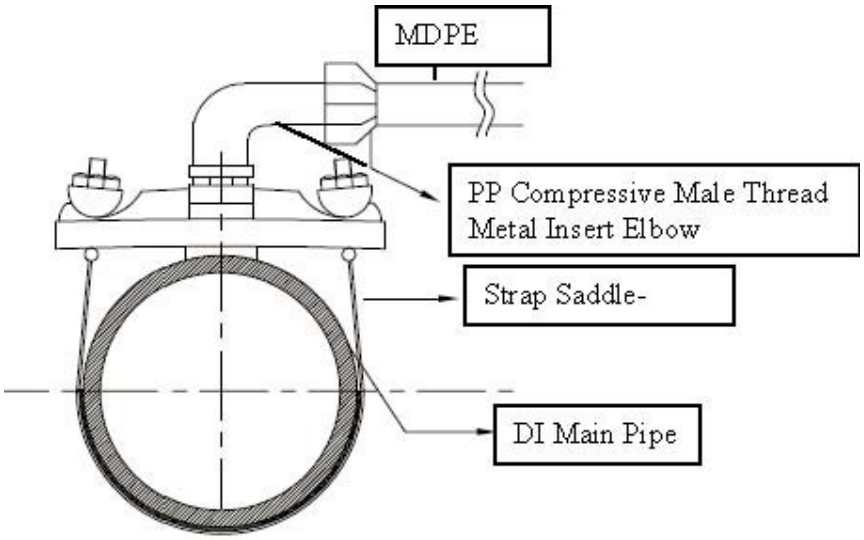
Saddle Body: Non-corrosive Engineering Plastic body moulded with Stainless steel threaded metal insert for tapping outlet. Also, the stirrup metal plate shall be duly embedded in the plastic body, except at the place of nut-bolt lugs. Threading size and dimensions shall conform

Note: The ‘MDPE’ as mentioned in the following drg. shall be read as ‘CPVC’.

to IS: 554. The body shall have retaining cavity housing for internal and external retention of the elastomeric seal. Sealing shall be achieved by pressure exerted by the body while fastening the saddle straps & body on the pipe.

Saddle Strap: Saddle straps shall be made of stainless steel 304 grade to prevent corrosion over the long service life. Strap Insulation: Elastomeric (rubber) insulation / lining shall be such that none of the Stainless-Steel Strap is in direct contact with the pipe. It shall ensure a firm non-slip grip mounting on the pipe to prevent the saddle from rocking or creeping on the pipe, as

might be caused by vibration, pressure or excessive external loading.



Saddle Seal: It shall be virgin rubber SBR Grade 30 / NBR (NSF 61 approved). It shall be of type pressure activated hydro-mechanical design. It shall be contoured gasket to provide a positive initial seal which increases with increase in the line pressure. Gasket shall be gridded mat, with tapered ends, with the outlet section having 'o' ring contacting the saddle body multiple o-rings contacting the pipe, preferably with a Stainless-steel reinforcing ring insert moulded to prevent expansion under pressure.

Nuts-Bolts- washer: Stainless Steel Type 304, NC rolled thread, Tightening torque for ½" (M12) nut-bolt: 14-15 kg.m and **for 5/8" (M 16) nut-bolt: 21-23 kg.m**
The general arrangement of Strap Saddle with PP Compressive Male Thread Metal Insert Elbow is shown below;

The joints in service connection between Cpvc pipe and UPVC Ball Valve and the Water Meter shall be tamper proof / not easily dismantled by the Consumers as directed by the Engineer.

Sl. No.	Item	Some of the makes preferred.
	Strap/Clamp Saddle	George fischer, Kimplas etc.,

(Any other reputed make as may be approved by BWSSB at a later date by producing the credentials.) QAP to be submitted for the approval by the employer.

7.19.2 Ferrule Materials

Compression fittings for house service connections shall comply with ISO 14236, with

materials of construction as per clause 5 in the Standard as follows:
Body polypropylene
Nut/cap - polypropylene Clip ring - POM (acetylic resin) Packing bush – polypropylene “O” ring - NBR Threaded metal inserts - SS304 with BSP threads

For clear identification of water services, fitting nuts shall be coloured blue and the body black. All threads shall be BSP.

The dimensions of compression fittings shall be in accordance with clause 7.1 of ISO 14236. The pressure rating of compression fittings shall be PN16 as per clause 8 of ISO 14236. Performance testing shall be as follows:

Clause 8.2.1 Leak tightness under internal pressure Clause 8.2.2 Resistance to pull-out Clause 8.2.3 Leak tightness under internal vacuum Clause 8.2.4 Long term pressure test for leak tightness for assembled joint Clause 8.3.2.1 MRS value as per ISO 9080 Clause 8.3.3.1 Resistance to internal pressure All materials or components coming into contact with potable water shall comply with the following: Metallic components shall not constitute a toxic hazard, shall not support microbial growth and shall not give rise to unpleasant taste or odours or discoloration.

- Non-metallic components shall be approved as being free from adverse health effects.

Compliance with national or international standards shall be demonstrated by
production of appropriate third-party certification.

Compression fittings for the conveyance of water for human consumption shall conform to BS 6920 for the effects on water quality, and certificates demonstrating compliance with the following parameters shall be provided: odour and flavour of water, appearance of water, growth of micro-organisms, extraction of substances that may be injurious to public health (cyto toxicity), and extraction of metals.

7.2 Flexible Couplings and Flange Adaptors

Slip-on type couplings shall include the following couplings:

(i) straight flexible couplings;
(ii) stepped flexible couplings;
(iii) flange adaptors.
(iv) dismantling joints

The pressure rating of the couplings shall be suitable for 16 bar working pressure and a test pressure of 24 bar.

The preparation of pipe ends for slip-on type couplings shall be in accordance with the requirements of and the tolerances specified by the joint manufacturer. Couplings shall be installed fully in accordance with the manufacturer's recommendations.

All couplings shall be supplied with transit protection.

7.2.1 Flexible Couplings

Flexible couplings shall be of the steel bolted compression ring type in accordance with AWWA C219.91, capable of allowing flexibility of the joint and removal of the attached pipework. Unless indicated all couplings shall be supplied without the central register.

Protection, both externally and internally, shall be a nylon coating in accordance with UK WIS 4-52-01: Part 1.

7.2.2 Flange Adaptors

Flange adaptors shall be of a bolted compression ring type in accordance with AWWA C219.91, allowing flexibility of the joint and removal of the attached flanged pipework.

They shall be given nylon coating in accordance with UK WIS 4-52-01: Part 1.

7.3 Valves

7.3.1 General

Valves shall be as per internationally recognised standards. Flanges shall be machined on faces and edges to ISO 7005, IS 6392 or BS 4504. All valves shall be PN 16 rating with PN 16 flanges.

Valves, with the exception of service connection valves, shall be double flanged types and the face shall be parallel to each other and flange face should be at right angles to the valve centreline. Backside of valve flanges shall be machined or spot faced for proper seating of the head and nut.

Valves buried or installed in an underground chamber, where access to a hand wheel would be impractical, shall be operated by means of an extension spindle and/or keys.

Valves of diameter 450 mm and above shall be provided with lifting eyes and shall have detachable bolted covers for inspection, cleaning and servicing.

Valves shall be suitable for frequent operation as well as operation after long periods of idleness in either open or closed position.

The valve stem, thrust washers, screws, nuts and all other components exposed to water shall be of a corrosion resistant grade of stainless steel. Valves shall be free from sharp projections.

Butterfly and non-return valves shall be provided with a bypass arrangement. This may be integral with the valve or connected between pipes.

Wherever required, valves shall be housed within chambers as per **Drawing as per approved drawing**.

7.3.2 Sluice Valves

Sluice valves shall be resilient seated and generally conform to IS 14846 / BE EN 1092 – 2 / AWWA C 509 / DIN 3352 or relevant internationally recognised standards.

They shall be of the non-rising spindle type and shall close in a clockwise direction. Resilient seated sluice valves should be glandless.

All

Component MaterialBody / Dome / Bonnet SG Iron IS 1865 Gr. 500/7 Wedge SG Iron IS 1865 Gr. 500/7 (food grade quality)with EPDM encapsulatedStem (non – rising) SS 410 Wedge Nut Bronze Bonnet Gasket EPDM Gland seal O-ring EPDM

valves, spindles and valve key caps shall be positioned to give good access for operational personnel.

a). The body and bonnet of the valve should be of ductile Iron of grade GGG50.

b). The Wedges should of EPDM chlorination resistant rubber with NFS /WRAS approval.

c). The Wedge Nut shall be fully integrated part of the wedge.

Materials of construction: The size of valves and pressure ratings are to be as per the Bill of Quantities. The Contractor shall provide test certificates for materials, strength and leakage shall be in accordance with BS 5150/IS 780.

7.3.3 Air Valves

Air valves shall conform to IS 14845 or relevant internationally recognised standards.

The air valve shall be capable of exhausting air from pipework automatically when being filled, the air being released at a sufficiently high rate to prevent the restriction of the inflow rate. Similarly, the valve shall be capable of ventilating pipework automatically when being emptied, the air inflow rate being sufficiently high to prevent the development of a vacuum in the pipelines. The valve shall also automatically release air accumulating in pipework during normal working conditions.

Air valves shall be of the double chamber, double orifice type with a large orifice for air entry into the pipeline and smaller orifice for automatic release

of air under normal working pressure. The valve shall be suitable for the maximum working pressures in the system. All air valves shall be provided with an isolating valve and flanged end connections.

Air valves shall be designed to prevent premature closure prior to all air having been discharged from the line. The orifice shall be positively sealed in the closed position but the float (ball) shall only be raised by the liquid and not by a mixture of air and liquid spray. The seating shall be designed to prevent the floats sticking after long periods in the closed position.

Air valves shall comprise a cast iron body having faced and drilled flange at inlet and with two chambers each housing a ball. One chamber shall have a small orifice and the other a large orifice. Balls shall be of stainless steel only.

Materials of construction:

Component	MOC
LP / HP chambers	CI IS 210 Gr. FG 260
LP seat ring	Gun Metal IS 318 Gr. LTB 2
HP Orifice	EPDM
Floats	SS AISI 304
Ferrule	SS
Isolating Valve	SG Iron D/F sluice valve with Cap; Resilient seated non - rising spindle as per IS 14846.

Valves shall be as per the BoQ specifications and shall be PN16 pressure rating. The location of valves shall be agreed with the Engineer.

The Contractor shall provide test certificates for materials, and properties shal1 be in accordance with relevant standards.

Before carrying out pipeline pressure testing the Contractor shall verify with the supplier of the air valves that the valves have the capacity to sustain the pipeline test pressures. In the event that they do not sustain the pressure, the valves shall be removed and the stubs off the pipeline shall be blanked off before pressure testing the pipeline.

Stubs for air valves shall be as specified and shall be fabricated to the required dimensions by the Contractor, who shall then fix them to the pipeline.

7.3.4 Nuts, Bolts, Washers and Gaskets

Unless otherwise specified, nuts, bolts and washers shall be galvanised and/or zinc electroplated to conform to the requirements of IS 1364. Bolts shall be of sufficient length so that at least one thread but not more than

three threads shall protrude through the nut when in the fully tightened condition.

All gaskets shall be manufactured from SBR rubber in accordance with IS 5382. The dimensions of flange gaskets shall comply with BS 4865.

7.4 Anchor Blocks

Anchor blocks shall be provided at horizontal bends, vertical bends/ and at intervals on pipelines with gradients in excess of 1 in 6 as noted on the drawings, and at other locations ordered by the Engineer. The anchorages shall be made from concrete and constructed to the dimensions shown on the drawings. Where faces of anchor blocks are shown to bear against undisturbed ground, the contractor shall take all necessary measures to ensure that such bearing is given over the full dimensions shown.

Curves formed by welded bends and pipe lengths will not require anchoring unless specifically shown in the drawings.

Welded pipelines shown on the drawings as having tied couplings an flanges shall require anchor blocks only at the positions specifically noted on the drawings.

7.5 Vertical Thrust Blocks

Vertical thrust blocks shall be located wherever there is a transition between above ground and buried pipelines. All vertical thrust blocks shall have flexible joints at either end to allow for small amounts of settlement to occur. The contractor shall undertake the construction of the thrust blocks as early in of settlement to occur. The contractor shall undertake the construction of the thrust blocks as early in the program of work as is practical and at least six months prior to the installation of the above ground pipeline, in order to reduce the risk settlement of imposing additional loads on the pipeline supports.

Where possible the base of the thrust block shall be cast against solid rock in order to prevent any settlement. Any material overlaying the rock shall be excavated and replaced with class M15 mass concrete. In the event of no rock being encountered the base of the thrust block shall be cast against undisturbed ground. Any ground which in the Engineer’s opinion is unsuitable shall be excavated and replaced with class M15 mass concrete.

7.6 Stubs

Stubs for air valves, scour valves and pressure relief valves of required dimensions as specified in the drawings shall be fabricated by the contractor and shall be fixed to the pipeline as per site requirement and instructions of the Engineer-In-Charge

7.7 Geogrid specification- Laying of Geogrid as per drawing and specification in accordance with MORTH specification clause 703.2.2 in two layers with proper confinement using GSB material of grade-II as per MORTH specification properly compacted in layers as per specification complete including verification of SBC.

7.8 Approved EMF Meters**:** Make- ABB, Scheinder, SIEMENS, Crone Marshal.

SECTION 8:

DRAWINGS

SECTION 9:

BILL OF QUANTITIES

Note:

(1) Item for which no rate or price has been entered in will not be paid for by the Employer when executed and shall be deemed covered by the other rates and prices in the Bill of Quantities (refer: ITB Clause 11.2 and CC Clause 37.2).

(2) Unit rates and prices shall be quoted by the Tenderer in Indian Rupees.

(3) Where there is a discrepancy between the rate in figures and words, the lower of the two will govern. [ITT Clause 24.1(a)]

(4) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by quantity, the unit rate quoted shall govern [ITT Clause 24.1 (b)]

SECTION 10:
FORMAT OF BANK GUARANTEE FOR SECURITY DEPOSIT

To: _____ [name of Employer]
_____ [address of Employer]
WHEREAS _____ [name and address of Contractor] (hereinafter called "the Contractor") has undertaken, in pursuance of Contract No. _____ dated _____ to execute _____ [name of Contract and brief description of Works] (hereinafter called "the Contract");
AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;
NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Rs._____ [amount of guarantee] [63]_Rupees_____ _____[in words], and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of guarantee][64] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.
We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.
We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.
This guarantee shall be valid until 30 days from the date of expiry of the Defects Liability Period.
Signature and seal of the guarantor _____
Name of Bank _____
Address _____
Date _____

[63] An amount shall be inserted by the Guarantor, representing the percentage of the Contract Price specified in the Contract

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AND WHEREAS it has been stipulated by you in the said Contract that the Contractor shall furnish you with a Bank Guarantee by a recognized bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract;
AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;
NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you, on behalf of the Contractor, up to a total of Rs._____ [amount of guarantee] [63]_Rupees_____ _____[in words], and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of _____ [amount of guarantee][64] as aforesaid without your needing to prove or to show grounds or reasons for your demand for the sum specified therein.
We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.
We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.
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